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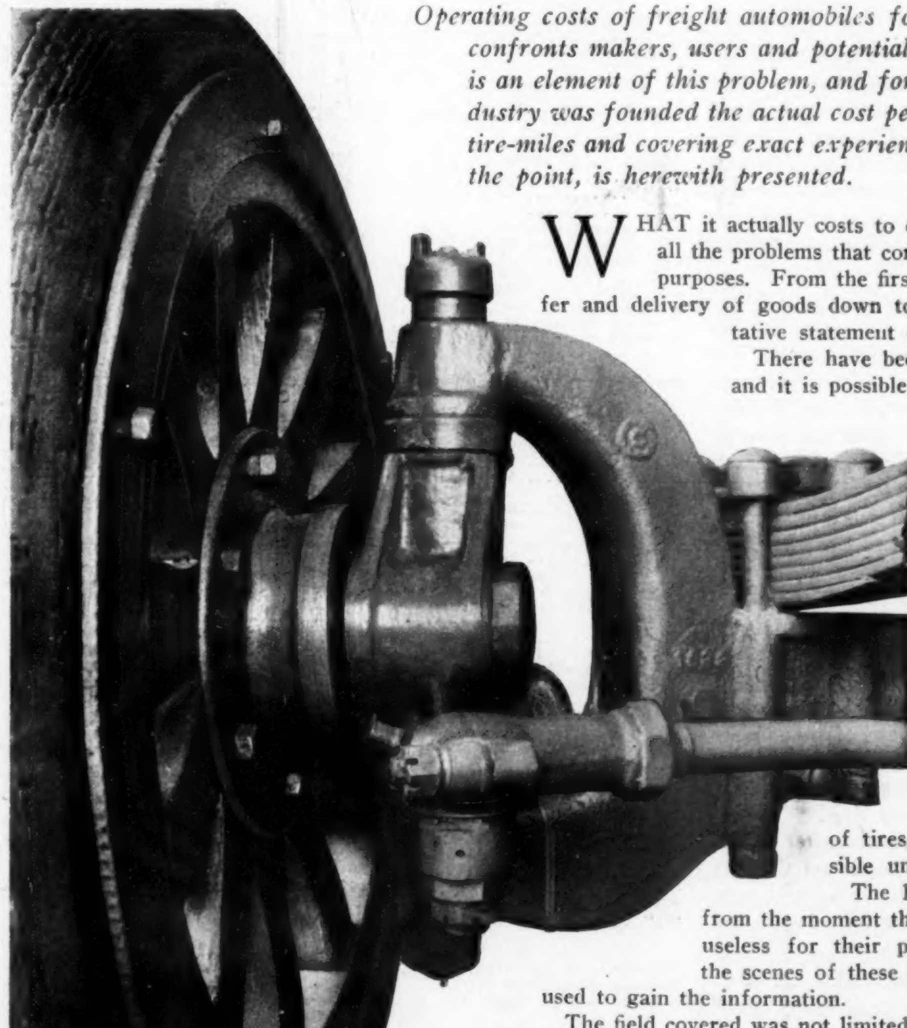
The Automobile

What Tires Cost for Freight Trucks

First Broad View of Vital Operating Question

Operating costs of freight automobiles form the most important question that confronts makers, users and potential users of the truck. The cost of tires is an element of this problem, and for the first time since the automobile industry was founded the actual cost per mile for tires, based upon millions of tire-miles and covering exact experience with enough tires to really illustrate the point, is herewith presented.



Example of solid tires of the general type under discussion

WHAT it actually costs to operate motor trucks is the most opaque of all the problems that confront the users of automobiles for business purposes. From the first application of power wagons to the transfer and delivery of goods down to the present nothing like a clear, authoritative statement of the cost has been given to the public.

There have been statements of all kinds and descriptions, and it is possible that some of them may have been near the truth, but none to date has been given that carried with it the assurance of authority. All the manufacturers of motor trucks are able to approximately estimate the cost of operation for the first year under certain conditions and to estimate the costs for the second and subsequent years, basing their figures upon the experience each has met with. But as far as the general question is concerned, they may be very wide of the mark as measured by the gauge of actual practice.

The Automobile in the following article is able to present the phase of truck operation cost contained in the element of tires, with a degree of detail never before possible under any conditions.

The life story of 1,000 motor truck tires is told from the moment the tires were put into service until they were useless for their purpose. Six typical American cities were the scenes of these tests, and eight leading makes of tires were used to gain the information.

The field covered was not limited to a series of academic tests, but represents actual business under real business conditions. Some of the cities are set upon seven or more hills, and others are flat as the proverbial pancake. In some paving conditions approach the ideal, while in others the going is bad. The experience here chronicled extends over a period of years, and the material at hand would allow of using 2,000 tires as the basis for this article quite as easily as it does 1,000. The various lines of trade represented in the figures are those that use the motor truck with the greatest strenuosity. The lines in which automobile trucks haul average loads over smooth pavements at well-regulated speeds are not particularly emphasized, and the figures that have been obtained are in no sense ideal, but they do present the practical results.

In the first place, while the average tire equipment of a motor truck costs about the same as a set of pneumatic shoes and tubes for a pleasure car, they give three times the mileage, and because of the fact that they are not equipped with tubes the real cost is only about one-quarter what it would be for a corresponding mileage in a big touring car.

The average cost of truck tires per mile per tire, based upon real experience with 1,000 of them, is .00443 cent. That means the tire cost for operating a truck for one mile would be .01772, and as the average load carried by the trucks considered was over 4,000 pounds, the ton-mile tire cost was .00774, approximately. This conclusion is based upon millions of tire miles, carefully recorded and compiled.

The casing used on a touring car lasts about 3,500 miles. The solid tire upon a truck runs 11,182 miles. The touring car tire may last six months, but the truck tire goes along four times that period of time. Sharply opposed to the experience of the pleasure car, the rear tires of a truck are materially longer lived than those on the front wheels. In the pleasure car the mileage from the rear tires is much less than that given by those that do not carry the power of the engine. In the truck it is somewhat greater for the driving tires than for those which are used for steering.

Conditions of Test Differed Widely in Six American Cities, Thus Making its Basis Broad Enough Upon Which to Found a Series of General Conclusions With Regard to Service.

The six cities from which the illustrative matter was derived are all different in topography, and there is a large measure of difference in weather conditions that obtain in each. For instance, in such cities as Chicago and Cleveland, where the land is flat and very large mileages are required of the trucks, the tire cost is higher than it has proved to be in some other places where there are heavier grades and where less speed is necessary in order to meet schedules.

The principal sizes of tires examined were 32 x 4, 32 x 3 and 36 x 4 inches. Fully 60 per cent. of all the tires used in this illustration were of the 32 x 4 size. Where all four wheels were equipped with this size the test showed that the rear tires gave nearly 1,000 miles more service than those in front, tire for tire. But the conditions were sharply reversed with the tires of larger diameter. For instance, with the 36 x 4-inch size the front tires delivered much more mileage. Not all the trucks were equipped with identical sizes of tires on all four wheels. One of the accompanying tables shows that a front tire 36 x 3 1-2 inches was used very largely in conjunction with a wider type of tire on the rear wheels. This circumstance will account for the higher cost per mile of the tires on the driving wheels as compared with that of the front wheel equipment. The rear tires were larger and delivered more miles per tire, but the money cost of them was somewhat higher.

One lesson that may be drawn from this phase of the subject is that uniform equipment gives uniform service, and that a trifle more tire substance in front would have a tendency to increase the mileage obtained from the set of four tires.

It is obvious that if a right front tire gives out after it has gone 10,000 miles in conjunction with its colleague on the left front wheel, the right tire cannot be replaced with a new one unless the truck is given a slight list to the left, due to the lift of the front wheel by the new tire.

This could do the truck mechanism no good, and it certainly would have a bad effect upon the new tire, because, being larger than its fellows, it would have to bear more of the burden and be subjected to much more than its share of the friction on the pavements.

The ideal condition for truck tire service would be one similar to the "One-horse Shay" of song and story. It will be remembered that this legendary vehicle was composed of such excellent material that it ran on and on, long past the period when its contemporaries had been consigned to the scrap heap. At last one day it disintegrated unanimously and simultaneously into little piles of wood dust and iron rust. The story it told was that its component parts were so nearly equal in strength that they "stood-up" together until one part gave way, and then all resolved themselves into their elements.

Life Story of 1000 Tires

Make	Number	Cost	Mileage
"A"	213	$11,699.42	2,767,403
"B"	244	11,024.90	2,619,327
"C"	433	21,446.49	4,841,806
"D"	75	3,757.71	701,332
"E"	4	213.05	32,337
"F"	8	370.71	55,860
"G'	4	175.32	30,794
"H"	19	906.05	133,997
Totals	1,000	$49,593.65	11,182,856
Average cost per tire			$49.53
Average mileage per tire			11,182
Average cost per mile			.00443

The Story as Told in Syracuse

Make	Number	Size	Mileage	Cost	Cost per Mile	Ton-Mile 4 Tires
"A"	2	36x3 1-2	27,048	$82.65	.0030	.0042
"A"	5	36x4	42,406	280.00	.0066	.0090
"B"	13	36x3 1-2	171,050	571.39	.0033	.0046
"B"	22	36x4	207,508	1,227.60	.0058	.0081
"C"	56	36x4	593,552	2,862.16	.0048	.0066
"D"	2	36x3 1-2	20,048	84.75	.0042	.0058
"H"	1	36x4	9,720	54.00	.0060	.0076
Totals	101		1,071,332	$5,162.55	.0048	.0066
Average cost per tire						$51.11
Average mileage per tire						10,617
Average cost per mile						.0048

Results of the Experience in New Haven

Make	Number	Size	Mileage	Cost	Cost per Mile	Ton-Mile 4 Tires
"A"	10	32x4	164,614	$508.70	.0031	.0058
"A"	22	36x4	369,856	1,240.20	.0033	.0039
"B"	81	32x3	973,199	2,454.62	.0025	.0047
"B"	30	36x4	369,137	1,705.45	.0046	.0054
"C"	84	36x4	1,030,344	3,308.76	.0032	.0048
"D"	7	36x4	85,764	393.00	.0046	.0054
Total	234		2,992.914	$9,610.73	.0032	.0048
Average cost of tires						$39.39
Average mileage of tires						12,266
Average cost per mile						.0032

How They Stood the Test in Chicago

Make	Number	Size	Mileage	Cost	Cost per Mile	Ton-Mile 4 Tires
"A"	37	32x4	323,979	$1,859.18	.0057	.0098
"B"	52	32x4	409,821	2,729.38	.0066	.0114
"B"	1	32x3 1-2	6,071	42.23	.0069	.0119
"C"	100	32x4	765,900	5,079.50	.0065	.0113
"D"	40	32x4	282,578	1,987.72	.0070	.0121
"D"	2	32x3 1-2	9,684	98.56	.0101	.0175
"H"	14	32x4	94,413	662.52	.0070	.0129
"E"	3	32x4	22,698	173.43	.0076	.0131
"F"	5	32x4	38,530	258.67	.0067	.0115
"F"	3	32x3 1-2	17,230	112.04	.0065	.0112
Total	257		1,970,704	$13,003.22	.0065	.0113
Average cost of tires						$50.79
Average mileage per tire						7,659
Average cost per mile						.0065

Digest of Tire Performance in Milwaukee

Make	Number	Size	Mileage	Cost	Cost per Mile	Ton-Mile 4 Tires
"A"	46	32x4	731,947	$2,340.02	.0032	.0055
"A"	2	36x4	26,866	112.00	.0041	.0048
"B"	5	32x4	66,467	252.54	.0038	.0065
"B"	1	36x4	16,604	56.00	.0034	.0039
"C"	67	32x4	1,012,370	3,428.39	.0034	.0058
"D"	9	32x4	122,171	458.83	.0038	.0065
"D"	1	36x4	10,634	56.00	.0053	.0061
"H"	1	32x4	7,471	50.87	.0068	.0117
Totals	132		1,994.530	$6,754.65	.0034	.0058
Average cost per tire						$51.17
Average mileage per tire						15,110
Average cost per mile						.0034

Tabular Résumé of the Boston Results

Make	Number	Size	Mileage	Cost	Cost per Mile	Ton-Mile 4 Tires
"A"	44	32x4	662,974	$2,191.22	.0032	.0062
"A"	3	36x4	44,920	168.00	.0037	.0044
"B"	9	32x4	158,753	457.83	.0029	.0038
"B"	2	36x4	25.390	107.30	.0042	.0050
"C"	48	32x4	536,736	2,376.00	.0042	.0062
"C"	6	36x4	67,092	297.60	.0042	.0075
"D"	9	32x4	130,367	457.83	.0035	.0066
"D"	1	35x4	17,162	56.00	.0030	.0038
Totals	122		1,643,394	$6,111.78	.0037	.0062
Average cost of tires						$50.09
Average mileage per tire						13,470
Average cost per mile						.0037

What the Figures Show in Cleveland

Make	Number	Size	Mileage	Cost	Cost per Mile	Ton-Mile 4 Tires
"A"	28	36x3 1-2	243,502	$1,189.25	.0048	.0061
"A"	14	36x4	129,291	780.60	.0060	.0075
"B"	11	36x3 1-2	86,056	473.32	.0055	.0068
"B"	17	36x4	129,271	947.24	.0073	.0091
"C"	62	36x3 1-2	516,398	2,992.12	.0057	.0072
"C"	10	36x4	83,290	482.60	.0057	.0072
"D"	2	36x3 1-2	17,931	113.72	.0063	.0079
"D"	1	36x4	5,193	51.30	.0100	.0124
"H"	2	36x3 1-2	17,187	82.66	.0046	.0058
"H"	1	36x4	5,206	56.00	.0108	.0135
"G"	2	36x3 1-2	20,608	75.32	.0036	.0045
"G"	2	36x5	10,186	100.00	.0098	.0123
"E"	1	36x3 1-2	9,639	39.63	.0041	.0051
Total	153		1,274,388	$7,383.76	.0057	.0072
Average cost of tires						$48.26
Average mileage per tire						8,329
Average cost per mile						.0057

Difference in Service Between Front and Rear Tires

Size.	Position.	Cost Mile.
32x4	Front	.0046
32x4	Rear	.00444+
32x3	Front	.0022
32x3	Rear	.0027
36x3½	Front	.00436
36x4	Front	.00475
36x4	Rear	.00506
36x5	Rear	.0098—
Average cost per mile of front tires		.00397
Average cost per mile of rear tires		.00489

Adjustments Cut Some Figure

Number of adjustments on 32x4 tires	16
Number of adjustments on 36x4 tires	9
Total number of adjustments	25
Value of tires involved	$1,000
Mileage saved by adjustments	200,000

Thus the average amount salvaged was $1 per tire.

Tires, Sizes of Trucks Considered

Taking tires 32x4	454
Taking tires 32x3	129
Taking tires 32x3½	5
Taking tires 36x3½	101
Taking tires 36x4	208
Taking tires 26x5	5
Total number of cars	902
Average mileage of cars	2,795
Average tire cost per car	$49.52
Average per mile cost	.01772
Ton mile cost approx (weight of car included)	.00774

Average Mileage of the Various Sizes of Tires

Size.	Position.	Mileage.
32x4	Front	10,859
32x4	Rear	11,773
32x3	Front	13,746
32x3	Rear	11,348
36x3½	Front	8,378
36x4	Front	14,201
36x4	Rear	10,805
36x5	Rear	5,093
Average mileage of 1000 tires		11,128

Average Life of Tires in Terms of Time

Size.	Position.	Life in Months.
32x4	Front	26
32x4	Rear	30
32x3	Front	24
32x3	Rear	21
36x3½	Front	24
36x4	Front	24
36x4	Rear	35
36x5	Rear	13

Average life of tire in months, 24 months.

Extremes and Means of Tire Mileage

Greatest mileage obtained in this test was 33,476.

This was from a 36x4 tire used on the front wheel of a two-ton electric truck in New Haven.

Length of service was 46 months.

The least service from any of the 1000 tires upon which no adjustment was received was 4,324 miles.

The tire was 32x4 and was used upon the front wheel of a one-ton gasoline truck in Chicago. It was in service 11 months.

The average life of a tire is 24 months.

The average mileage secured from a tire is 11,128.

In truck operation, referring specially to tires, that is the ideal condition. It is proved by long experience that one should not put new wine into old bottles, and it is demonstrated by the figures at hand that one thick new tire with three old ones is not what might be termed a happy combination. The corrective measure indicated is to install tire equipment that will give equal service on all four wheels, or at least to arrange matters so that a single new tire will not have to be placed in conjunction with three old ones; or in the alternative to stand the loss of perhaps 1,000 miles from discarding the three old tires in order to keep the truck in operation. Interchangeable wheels would go a long way toward simplifying this phase of the problem.

Of the six cities considered, the one in which the lowest per tire mile cost was experienced was one that has no heavy grades and where also high speed was not practiced. The tire equipment there was the lightest on the general average of any of the cities observed. The cost per tire mile was only .0032 cent, or per truck mile .0128, while the ton-mile cost was .0048. This would indicate that the average load in that city was somewhat over 5,000 pounds. As a matter of fact, most of the trucks were rated at one-ton carrying capacity and weight, and consequently they must have delivered a material overload on practically every trip.

The average tire mileage achieved proved to be 12,266, which is only about 1,000 miles per tire above the general average. The marked decrease in per-mile cost is accounted for in the small amount of money outlay for the tires. This resulted from the lighter weight and smaller size used. The average cost per tire was only $39.39, being brought down by the fact that among the 254 tires used there were 81 that were of 32 x 3 size. In this city there was a determined effort to limit speed, and, while fifteen miles an hour was frequently made, it is doubtful if that rate was materially exceeded. The average speed there was a trifle more than twelve miles an hour.

The Manufacturers' Contest Association recommends in its recently issued rules that trucks shall not be operated faster than eight miles an hour. If such a rate of speed could be enforced the life of tires would be increased at least 100 per cent. on the general average, to say nothing of the years that would be added to the motor and body, and the dollars that would be saved in unnecessary repairs.

There Proved to be Considerable Variation in the Mileage Returned Even by Similar Types and Sizes of Tires, Due to Quality and the Conditions Under Which They Were Used.

The city in which the greatest mileage was obtained from tires is likewise devoid of heavy grades. Only about half as many tires were used there as were in service in the foregoing account of the other town. The average mileage was 15,110 per tire. Here the vast majority of the tires were 32 x 4, and all four wheels were equipped alike. The tires used averaged higher in price than those of any other city, being $51.17 apiece. The cost per tire mile was .0034, and per truck mile .0132. The ton-mile figure was .0058, indicating that the average load carried was slightly less than 5,000 pounds. Speed was regulated to a certain extent, but not to such a degree as it was in the city referred to previously. The tire equipment of the trucks of this city was lighter than the general average and was largely of the 32 x 4 size.

The next city in rank of per-mile tire cost is in New England. The average mileage was considerably over the general level, the figures being 13,470 per tire. The pavements were generally good and grades were not a material obstacle to progress. The favorite size of tire was 32 x 4 inches, and the average cost per tire $50.09 and the per-mile tire cost .0037. This would make the truck mile .0148. The ton-mile cost was about the average. There was quite an element of excessive speed in this city, which accounts for the lessened efficiency of tire service as compared with the example immediately preceding.

A big up-State New York town ranks next in order of economy. There were 101 tires used in the service under observa-

tion. In this city big tires were the order of the day, and it is interesting to note that the mileage delivered was less than that of the smaller types. The average proved to be 10,617 miles. On account of the size of the tires used, the cost was higher than it was in four of the six cities, and was exceeded in only one of them. The average was $51.11. The tire-mile cost was only slightly greater than the average, being .0048. This would indicate a per-mile cost of .0192. Because the trucks were generally larger than the average, the ton-mile figures were well under the average in the matter of tire consumption.

Fifth in the list, as far as the tire-mile cost is concerned, was a big lake city, where there are a number of moderate grades. Big wheels, fitted with big tires, were used exclusively. Seven different makes of tires were used here, all of which were 36 inches in diameter, the treads being from 3½ inches to 5 inches wide. The 5-inch tires were the worst in comparative performance, averaging only 5,093 miles. The 36 x 4 tires did not make a very favorable showing here, because in a number of cases this size was fitted to the driving wheels, while the 3½-inch tires were used to equip the steering wheels. It may have been a local condition that brought about the result, but it is quite certain that the best return was not secured. The 36 x 3½-inch size stood out clearly as the most economical in this city. The fact remains that both of the larger sizes did not make a good showing in comparison with the smaller size. The cost of tires here averaged $48.26, which was somewhat less than the average, but the tire-mile cost was .0057. This means a per-mile tire cost of .0228. The loads carried were in excess of three tons, and the ton-mile figures were .0072. The experience in this city would seem to indicate that a little heavier tire in front and a lighter type on the driving wheels would produce more economy in operation. It would also seem to show that the 3½-inch tire was superior in wearing qualities and general service than the wider

Speed Proved to be the Costliest Element in the Tire Situation, as Was Shown Repeatedly Throughout the Test. Tire Costs Increase as the Square of the Velocity.

The heaviest tire bills of the series were run up in one of the largest cities in the country where paving conditions, as far as the main boulevards are concerned, are well above the average. It may be noted, however, that the streets are restricted to a considerable extent and trucks are barred from the use of many that are available to the touring cars and horse-drawn pleasure vehicles. As a matter of fact the truck routes in this city are frequently laid out over streets that are far from the ideal. There are few hard grades in this territory and the idea of speed has been altogether too much emphasized in importance. The distances are long and the service demanded from the tires is strenuous under all the circumstances.

All these things are borne out sharply in the totals. It was found that in a mileage well over the million mark the tire mile cost was .0065, making the truck mile cost .0260. Added to this striking condition is the fact that small trucks were used and that 32-inch tires were the order of procedure. With six exceptions these were all 32 x 4 inches. The average mileage delivered per tire was only 7,659 and the ton-mile cost was .0113.

No good reason for this showing is presented in the cost of tires because it was well above the average, even of the prices paid for the larger varieties. It was $50.79, or $1.23 more than was paid for the general run.

As seven different makes were used, it is to be understood that the quality was equal to that of the tires used in other places and as the items of expense were sharply scrutinized the chances for faulty handling were very slight and do not afford a basis for such a condition as was developed.

The only other factor remaining is the one of excessive speed and that tells the story. It is said that one company operating trucks in this city makes a practice of exceeding 20 miles an hour on one of its regular schedules. Four trucks are used in this work and it may be noted that the records show that one of them has been out of service all the time since the service was 90 days old. This, of course, is due to mechanical difficulties which may be traced directly to the killing spe... required and is not due to tire troubles. However, these trucks use up a full set of 32 x 4 tires, that usually give at least 12,000 miles, in less than 5,000 miles of service.

Speed is a great element in modern civilization, just as it has always been in bringing about civilization and widening the scope of human activity and influence, but excessive speed has its general disadvantages and excessive truck speed is inexcusable. It may seem to be advantageous to push an automobile truck to the limit of its speed capacity in certain instances and for very short periods, but there is no advantage that can outweigh the disastrous results that must follow the maintenance of a high-speed regular schedule.

Take as an instance the experience of one of the drivers of a truck in service on the high-speed schedule referred to: For about a mile at the end of the run, there is a broad street paved with asphalt over cobblestones. When this stretch of road has been sprinkled either by rain or the watering carts it presents a fierce proposition to the driver. There is a terrific strain on the steering wheels in compensating for sudden skidding, and when the brakes are applied suddenly, as is often necessary, the rear tires are flattened by being dragged even short distances by the momentum of the truck.

The best showing made of any of the 1,000 tires observed was astonishing. This tire, which was 36 x 4 inches, was on the left front wheel of a two-ton electric truck. It was in service for nearly four years, being in regular use for 46 months. It was discarded recently after being worn so thin that it was useless. During its life, this tire did its part in traversing 33,476 miles. This is over one and one-third times around the world. Its companion front tire lasted 33,124 miles. These tires cost $56 each, which is materially more than the average for this size and about $6.50 above the general average. The tire cost per mile for the first referred to was .0014. If carried out all around, this would show a truck-mile cost of .0056 and a ton mile cost of .0028 if no overload was carried. As a matter of fact, as the trucks rated at two tons almost always carry 5,000 pounds or more, the actual ton-mile cost would be about .00224.

Truck operation on that basis would be reduced to such a level that no other kind of transfer and delivery medium would be considered for a minute, providing that the other items that go to make up the total ton-mile cost are correspondingly reduced.

On the other hand, the worst showing was made by a 32 x 4 tire used in the high-speed service more lengthily described above. This tire delivered only 4,324 miles and was discarded after it had been worn through by a long skid with locked wheels. It was thick, resilient and usable in every respect save that about 6 inches of the tread disappeared in the terrific friction of the tire and pavement. This tire cost $51 and was used on the driving wheel of a one-ton gasoline car.

The tire cost per mile indicated is .0118+, which would make the truck mile .0472. As the car was of one-ton capacity, the latter figure represents the ton-mile tire cost. Such an expense for tires, coupled with the high cost of maintenance that must go with excessive speed, would make the operation of motor trucks prohibitive.

Lessons Learned from the Test Were Chiefly as to the Necessity of Equipment That Will Return Equal Service on all Four Wheels and as to the Destructiveness of Speed.

Broadly speaking, the lessons learned from the examples observed are included under three heads. Big wheels and tires are better upon heavy grades, but are not so economical where the roads are flat. The 36 x 3 1-2-inch tires made an excellent showing in comparison with the wider varieties of this diameter.

The 36-inch diameter tire did not develop service and mileage corresponding to the increased cost over tires of 32 inches diameter. This may be accounted for in part by the fact that the 36-inch tires were used on the hills where the daily service requirements in miles were not so heavy as they were on the flat. Also, tire service varied considerably with the different makes and did not follow the lines of cost with much strictness.

Thus it was proven beyond doubt that much care should be used in fitting the tire equipment so that the service on all four wheels may be approximately equal. The figures show that a little more tire in front would help to achieve this end, but that individual requirements must be carefully considered.

Finally, the matter of speed is far and away the most important of all the deteriorating influences to which tires are subjected. At an average of 12 miles an hour, the life of a tire may be put down as not far from 11,000 miles. At 20 miles an hour it would be about 4,000 miles. At higher speeds its life would be materially shorter and extremely precarious and uncertain.

At 8 miles an hour the average life of a tire may be estimated at 20,000 miles, but so far complete data on that point is not available, as only a few companies in a few instances insist that such a rate shall be maintained. The difference between the cost of the first speed as against the second may be stated as follows: At 20 miles an hour, suppose that 4,000 miles are delivered at a tire cost of $200, the cost per mile per tire would be .0125 and per truck mile and ton-mile .0500. With the same equipment at 8 miles an hour, delivering 20,000 miles, the tire-mile cost would be .0025 and the truck and ton-mile costs .0100. That is a difference of 4 cents per ton-mile on tires alone. Added to this difference must be considered the difference in maintenance, which would be even more striking.

Canadian Motorists Uncertain as to Benefits of Reciprocity—Just at the present moment there is an attitude of uncertainty among the automobilists of Canada, because of the changes which are apt to be brought about in the event of new tariff regulations going into effect. It is estimated that the duty on motor cars would be reduced at least 5 per cent.

Cold Logic vs. Sophistry

The advent of the commercial vehicle necessitates a thorough revamping of the sales departments of those establishments that may have hoped to rely on salesmen who have hitherto dealt with pleasure cars only—the selling of business wagons is a strictly business proposition, and the man who hopes to succeed in that line must be ready to furnish indisputable facts as to low ton-per-mile costs; the blandishments that may prove efficacious in disposing of a pleasure car will be wasted effort in the selling of a freight truck.

SALESMANSHIP has been a naive commodity in the automobile art, partly on account of the ease with which passenger automobiles find lodgment in the possession of users, and for the rest, due to the high character of the talent that has been attracted to the automobile business, perhaps on account of the glamor that surrounds the transportation problem. The coming of the freight automobile is going to tax the ingenuity of makers, and the selling departments will have to reorganize, taking account of bulldog tenacity and cold logic, using the force of accuracy and the persuasion of truth, applying consistency instead of romance, pointing out the utility of the idea that they have to dispose of, estimating its value to the user in his business pursuit, remembering every minute that a man spends money recklessly when he is in pursuit of pleasure, but that he counts his pennies on a cash-register basis when he takes his place on the proprietor's side of a commodious flat mahogany desk. The man who relies upon sophistry to make a favorable impression is going to find himself looking into the eye of the fellow who knows the difference between a sophistry and the logic that stands analysis, proving the rule by locating the exception. The arguments that seem to tell when passenger automobiles are being disposed of are based upon high speed, high-gear hill-climbing work, and the bloom of the peach on the cheek of a toy tonneau. The arguments that will clinch a deal with a merchant who has goods to deliver will be based upon "ton miles per mill," and the man who can show a level rate of cost per ton mile and present a probability that can be looked upon in the light of a business risk is the salesman for whom there will be a lasting demand.

Good Roads and Routes--Touring

Joys of a 1,000-Mile Trip in Oregon's Mountains

Recounting the travels of a party of Portlanders who undertook the said-to-be-impossible trip from Oregon's metropolis to Crater Lake, and successfully completed it, after a variety of "roughing-it" experiences that made the venture all the more enjoyable.

FROM Portland to Crater Lake in a motor car—nearly one thousand miles through Oregon canyons and over mountain ranges—was looked upon as impossible. Nevertheless that is what we achieved, and this is the story of it.

Early on a beautiful autumn Sunday Miss Helen Harrah, of Detroit; Misses Mabel and Stella Riggs, Mr. and Mrs. Frank C. Riggs and E. J. Clark, all of Portland, stowed themselves comfortably in a Packard touring car and headed off toward Oregon City.

Soon we saw the glorious crest of Mt. Hood shining in the distance, a spectacle that had long been veiled by the smoke of forest fires. The roads were dustless by reason of an autumn rain and the panaroma was given a touch of unusual color by the Indian outfits that passed us on their return from hop picking. Their gay blankets and fantastic costumes blended in the riot of color that was turning frosted mountain tops to flaming pageants of red and gold.

Through Oregon City we passed, stopping just long enough to sip its historical interest, and plunged on to Salem, thence to Jefferson, where an ancient ferry conveyed us across the Santiam River. At 1.30 in the afternoon we entered Albany and spent the afternoon there. At five o'clock we were on the road to Eugene, where we laid up after a day's travel of one hundred and thirty miles.

Early Monday morning saw a lazy start, and soon we descried the triple peaks of the Three Sisters. All the morning we were climbing out of the Willamette Valley and into the Calipooia mountains, where we ate our lunch under the big trees. Farther on we reached the home of Frank B. Waite, which overlooks the Southerlin valley. Here we beguiled a few delightful hours, and a short run to Roseburg closed our second day with eighty-one miles.

The third day was one of bewildering variety. Leaving Roseburg with its hills and beautiful Umpqua river we struck the highway deep into the mountains, past Myrtle creek into Cow Creek canyon with its stiff eight-mile climb, and turned aside

from the road that leads to Grant's Pass into the narrow, steep and tortuous one that leads to Glendale. Fortunately we met no teams, for a passing was impossible. At the top of the grade a sharp swing around the mountain's nose gave us the romantic Rogue River valley, spread out before us for miles on miles.

We reached the main road again at Wolf's Creek, and so came to Grant's Pass and through it to the Table Rock, a natural fortress in which the Indians once took refuge. Mt. Pitt, glistening with snow, stands sentinel over this entire region. And now through a tangle of meandering roads that reach out like crooked fingers everywhither we came to Medford with its fertile meadows and extensive orchards, and here we spent three satisfying days.

It was on Saturday morning that we began our final dash to Crater Lake. Covering our car with eight-ounce duck to protect it from the wiry brush that skirts the narrow pass, we set out in a chill drizzle. The rain fell all day and by noon the roads were so slippery that we stopped to place the tire chains. Six hundred feet directly above the Rogue River on a narrow rocky ledge we confronted an emigrant outfit. Then we had the hazardous job of backing up a quarter of a mile to find a place wide enough to let them pass. We ate our lunch and drank of a mountain stream, hearing the while the weird sound of the rain in the mountain forest and the louder roaring of river. Farther on we passed indescribably beautiful cascades, foaming rapids and boiling falls, and came presently to the heart of the big timber region where the great sugar pines towered above us and the ground beneath was soft and fragrant with its carpet of pine needles. Its natural freedom from underbrush gives it the aspect of a limitless park.

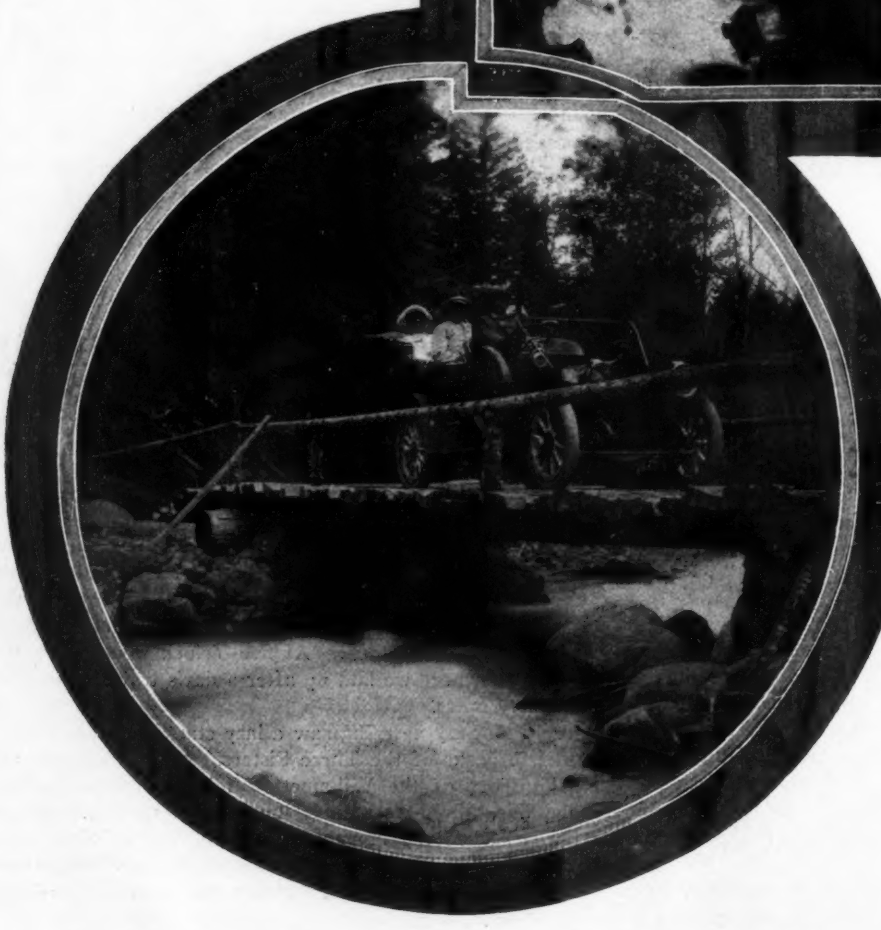


Fig. 1—Scene in Oregon—among the mountains and across the water

Fig. 2—At Rogue River Falls, looking down

Fig. 3—Crater Lake—at the beginning of the old Oregon trail

We were climbing higher now and the temperature was steadily falling, patches of snow showing here and there on the mountain side. At the lower camp on the mountain, whose volcanic top forms the basin of Crater Lake—Camp Arrant—we inquired for gasoline and found none. The camp was breaking up and the men were to leave next day. Soon the wind began to blow and we were in the midst of a typical snow storm. It was five miles to the rim of the Crater and the rise was one thousand feet, most of it in the last mile. When we left Medford the thermometer said ninety degrees; now it registered twenty-eight.

And now we were at the summit—the

Fig. 4—On the road—out of Medford, where the going is good

Fig. 5—Mount Scott, showing on the horizon with the lake 1,000 feet away

Fig. 6—Character of the scenery in the vicinity of Mount Scott

grand point of our unusual journey. Yet all we saw of the natural wonder we had come so far to view were rolling clouds of mist and the white fury of the snow storm. But never were travelers in the Alps received by the monks of St. Bernard with more courtesy and hospitality than our shivering party received in the crude hostelry of Mr. Steel. The hotel is but a temporary structure and the wind made free with it, but there was a welcome and a personal interest that made Broadway cheer look cheap in comparison.

We "housed" our car under the dripping trees, and soon the wet snow began to build a mound around it. We retired—to tents! There were blankets enough to make up comfortable, although the tips of our noses felt a mountain temperature at twenty-three degrees. We arose to gaze upon a scene of splendor. Far down the mountain side we could look endlessly into the lower country and count scores of gleaming lakes throwing back with the added luster the first rays of the opening day. The autumn-tinted marshes stretched out before us like great picture books gorgeously colored with all the tints of the sun palette. The nearest lake we saw was thirty miles away, and the farthest one hundred. The great marsh paintings which we beheld with shouts of admiration were sixty miles distant. We saw Mt. Shasta in her lonely, snow-crowned grandeur one hundred and fifty miles away and the lesser mountain peaks standing about her like courtiers around a throne. The air was crisp and exhilarating. The ground was white with snow. The landscape was magnificently wild.

But now for the wonder of this western world—Crater Lake. The shore is one thousand to two thousand feet above the water; the lake is seven miles in extent; Wizard Island, a peak that juts out of the lake, rises eight hundred and sixty-five feet above the water. The lake is the cup of an extinct crater, though how it became filled is one of the physical mysteries. No inlet has been discovered, and the government experts have found a depth of one thousand nine hundred feet over a stretch of four miles. It abounds in steel-head trout.

It was Sunday again, one week from the time we left Portland, and we spent the day drinking in the glories of the region. The magnitude of it all staggers the imagination. What distances! what tints! what lavish exhibitions of natural power! what richness of resource!

Descending, we passed the deserted lower camp and picked up a foot traveler to guide us to Fort Klamath, where we secured a few precious gallons of gasoline, enough to carry us forty miles to Klamath Falls. Making a return trip to Fort Klamath we had a hot supper in a hotel crowded with cowboys in from the ranges.

So here we were—four hundred miles from home, forty miles back to the nearest railroad station and one hundred and fifty miles ahead to the next one. With Portland friends, whom we had met in their Packard "18," we started ahead—there was no going back for us if we could help it. Through creeks, over roads across which trees had fallen, once into quick-sands and once through a mammoth herd of sheep, we pursued our way and came at night to a cheery wood fire at Bend after one hundred and fifty miles of rain and sleet and snow and mud. Next day we rode through pleasanter ways to Shaniko, and the following day we entered the little town of Biggs on the Columbia River, and here the ladies of the party boarded the train to Portland.

The speedometer registered eight hundred and seventy-five and six-tenths miles for the ten days. But we had made Crater Lake, and we made it in the worst season of the year.

Engineering Status of Pierce Truck

Looking at the Design Features with a Critical Eye

Presenting reproductions of the working drawings of the Pierce truck, showing the scheme of design and the method of transmitting the power of the motor through a speed change box and propeller shaft to a worm drive in the live rear axle. The plan for taking the thrust of the worm is shown in precise detail, and the utility of this scheme of transmission is discussed in a general way.

SLOW speed is the rational doctrine for freight automobiles, and silent performance is the broad aim. To get slow speed the Pierce-Arrow truck as made by the Pierce-Arrow Motor Car Co., of Buffalo, N. Y., has taken advantage of a worm drive for the live rear axle, which is shown in section in Fig. 1, bringing the worm W1 to the upper side of the worm gear G1, and lubrication is accomplished by the picking up of the lubricating oil O1 which normally rests in the lower half of the housing H1, bringing the level of the lubricating oil to a point slightly below the diameter of the jackshaft J1. The worm shaft S1 rolls on annular type ball bearings B1 and B2, and thrust as it is induced by the worm is taken in the two directions by means of the double thrust lock T1. Attention is called to the universal joint U1 and to the splining S11 of the worm shaft to take one-half of the universal joint and the splining S12 of the propeller shaft P1 where it fits in the other half of the universal joint. The fastening of the radius rod R1 by means of a pin P2 into lugs L1 and L2 is worthy of attention. The housing of the rear axle is prevented from rotating in response to the torquing of the motor, and this gain is realized without interfering with lateral flexibility, which is brought about by hinging the radius rod, using a pin in the manner as shown.

It is the function of the worm drive to take the power of the motor and deliver the same to the live rear axle through the differential gear, passing it onto the rear road wheels, and to do the work silently, permitting the motor to run fast and the automobile to go slow. Remembering that passenger automobiles are permitted to travel at least three times as fast as freight automobiles should go when running in high gear, remembering also that the gear ratio is approximately 4 to 1 in passenger automobiles, it is obvious that the higher ratio that is required in the freight automobile is only to be had in a complicated way unless this ratio can be established in some simple manner, as in the employment of a worm drive for the transmission of power to the axle. In working out the worm drive for this truck the basis of calculation is a 38-horsepower motor of the four-cylinder type with a bore of 4 7-8 inches and a stroke of 6 inches, the cylinders being cast in pairs and water cooled. Ignition is by a Bosch high-tension magneto on the right side of the motor, and the auxiliary ignition includes a separate unit coil with a master vibrator, the cur-

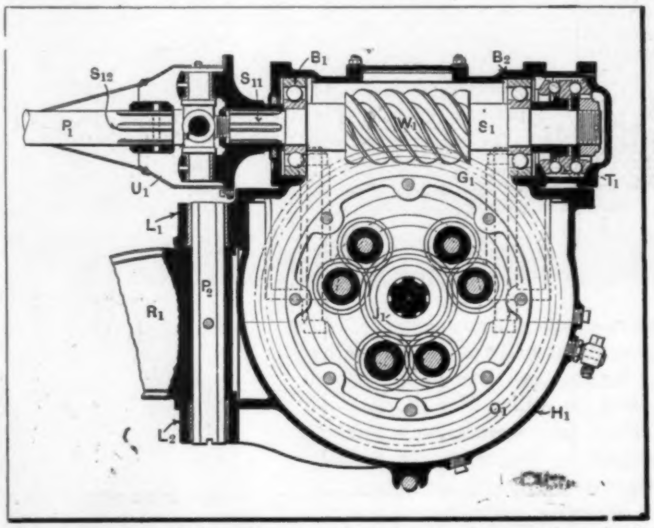


Fig. 1—Section of the worm gear drive in the plane of the propeller shaft, showing the worm above the wheel and lubricating oil in the bottom of the housing

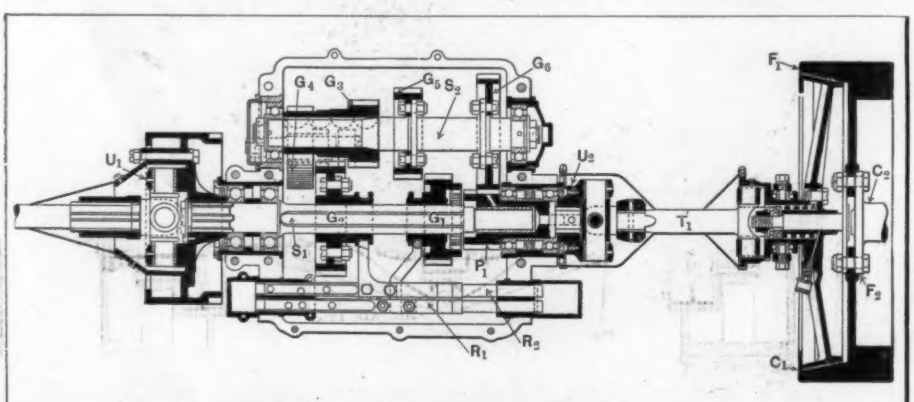


Fig. 2—Section of the transmission gear system showing the relation of the prime to the lay shaft, the mountings of annular type ball bearings and the scheme of direct drive.

rent being furnished by either a National or Exide storage battery. The carbureter is of the company's design, automatic in type, fitted with a hot-air intake, and water-jacketed. The conditions of the power plant are such that the motor characteristic includes a wide range of "stability," and the normal speed of the automobile on the road as it is interpreted by the worm drive is such as to draw upon the motor in the mean position of its range of stability. The speed of the car, under these conditions, driving on high gear, is 13 miles per hour, the wheelbase length being 156 inches with a 69-inch tread.

Variations in Speed on the Road Are Due to the Use of a Three-Speed Transmission Gear.

The weight of the chassis is 4,500 pounds, to which must be added 64 pounds of cooling water, and about 150 pounds of gasoline when the tank is filled. The weight with a body depends of course upon the type of body employed, and it is estimated that a stake platform body will bring the total weight up to 4,800 pounds, or a furniture van body will make the total weight 5,000 pounds. At all events, these are the general conditions that are brought to bear from the point of view of power, considering the weight, in the designing of the worm drive, and the ratio of the worm gear is regulated to give the road speed named, using 42-inch solid tires on the rear wheels, they being 5 1-2 inches in

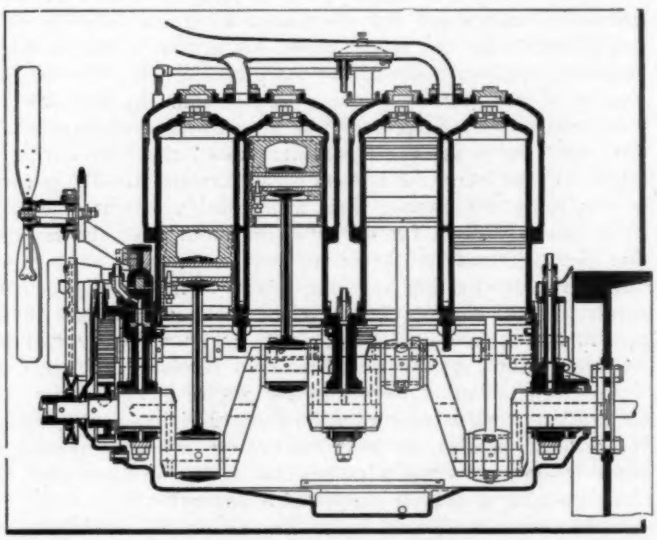


Fig. 3—Section of the four-cylinder water-cooled motor, depicting the details of designing and the means throughout for preventing the escape of lubricating oil or the entrance of silt of the road

section, using a double equipment. The front wheels are 35 inches in diameter with a 5-inch section single equipment.

Having fixed the gear ratio, using a worm drive for the facility that it affords, speed changes are made through a selective type of transmission gear, arranged for three speeds and reverse. This gear is shown in Fig. 2, showing the sliding shaft S1 and the lay shaft S2, and the change-speed racks R1 and R2, with their forks connecting with the sliding gears G1 and G2, with means for meshing with the low speed gear G3, or G4, by the sliding gear G2 for the low speed and reverse combinations, while the sliding gear G1 meshes with the gear G5 for the second forward speed change, and the meshing of the inverted pinion on the sliding gear G1 with the pinion P1 in the master train gives the high speed, thus permitting the lay shaft to rotate as an idler through the meshing of the pinion P1 with the master gear G6. Universal joints U1 and U2 are placed at the two ends of the sliding gear system, and from the universal joint U2 to the cone clutch C1 the connection is made by a tumble shaft T1. The bearings throughout are of the annular type in housings, and the method of mounting the bearings is in accord with approved practice. It will be observed that the cone clutch moves against the conical face in the flywheel F1, and the flywheel in turn is flanged F2 to the end of the crankshaft C2.

The general design of the motor will be gleaned by examining a section of the same as given in Fig. 3, which shows details along lines that have characterized Pierce-Arrow work in the past. One of the important points in trucking work is involved in the problem of lubrication, and Fig. 4 is another section through the crankshaft of the motor showing the oil reservoir above the cylinders and the scheme of piping to the oilways in the crankshaft, feeding the lubricant to the main and pin bearings. The used oil falls down into the bottom of the crankcase, and an oil pump placed at the lowest point is submerged by this product, lifting the same back to the reservoir above, where a strainer is placed for the purpose of cleaning the oil before it is permitted to rest in the reservoir. Next to lubrication the ignition system is of importance in this service, and Fig. 5 is a wiring diagram showing the magneto, coil, battery and timer, and the plan of their connections with a switch on the trunk of the coil box, which is placed in a convenient position on the dash, by means of which the operator is permitted to throw to the magneto or coil as the exigencies of service would seem to indicate, shutting down by the expedient of throwing the switch to neutral position.

Excellence of Mechanical Detail Is Shown in the Rolling Stock Construction.

Referring to Fig. 6 of the live rear axle in section, the vogue of the design is clearly brought out, showing the double set of 5 1-2 x 42 inch solid tires on each rear road wheel fitted on a common felloe, which in turn is supported by 16 substantial spokes of "white" hickory, rived from the butt of the tree, free from bird-pecks, heart wood and stains, selected on a basis of high specific gravity, and seasoned in the company's plant under the eye of a capable wheelwright. The spokes are mitred to the hub and tightly clamped between flanges, and the axle tube is reduced in diameter under the hub, accommodating large sizes of Timken roller bearings, they being placed in a point of vantage in the plane of the double set of tires. The jackshaft is squared at its end for each wheel, and the drive is through a disc that is flanged to the outer face of the wheel hub. The brakedrums are of wide face and the web of each drum makes the inner flange of its hub so that the holding bolts for the flanging are the retaining bolts for the brakedrum. The differential housing, including the worm drive, is in the mid-position between the wheels, and the method of building up the live rear axle, fixing the relation

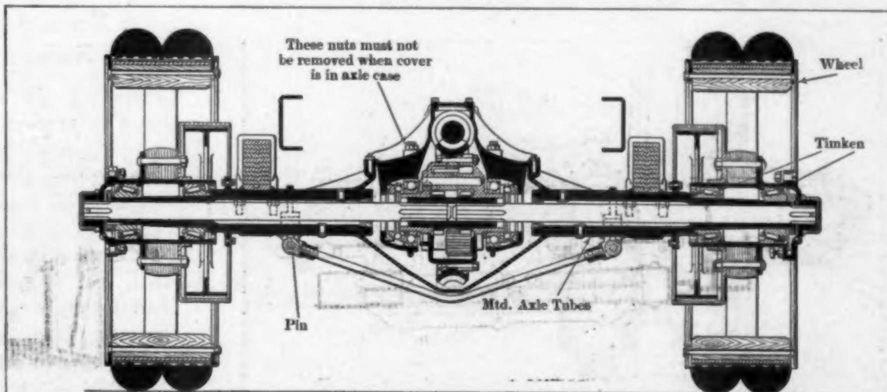


Fig. 6—Section of live rear axle, showing details of design of wheels, utilizing (double) solid tires, also building up of tube and location of differential housing in mid position

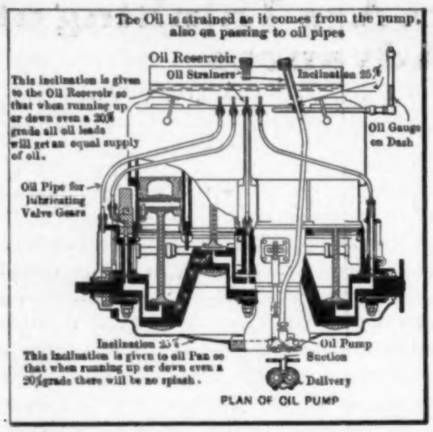


Fig 4—Section of the motor through the crankshaft, showing the oil reservoir above, the location of the circulation pump, and the channels for the movement of the oil to the bearings to be lubricated

of the functioning members, is clearly brought out in section in Fig. 6.

The front axle construction is shown in Fig. 7. The axle proper is a die forging of the I-section and the knuckle, which is a drop-forging also, swivels on a hardened pin that is fastened into the I-section with a taper fit T1. The front hub is designed to accommodate Timken roller bearings, and the steering arms are drop-forgings of substantial section.

It is the practice in this plant to anneal all forgings after each operation; this is for the purpose of refining the structure of the steel. In the final inspection of the parts attention is paid to the physical state of the material.

Time is the Producer of Quality

Inventors fail in the majority of their undertakings, due to the fact that they think ahead of their time. The world moves, but it declines to dance to the music of the pioneer, and, as the story goes, time rings in the change that makes for better things, maintaining an even balance of the contending principles, i. e., supply versus demand. The demand at the present time is for better automobiles, and the sources of supply are making provision accordingly.

EMANCIPATING the slaves as an academic proposition was given the center of the stage 40 years before the fact. The surgical operation that brought about the real emancipation was performed when time said, "Let there be emancipation." Transferring this thought to the automobile business, and for the purpose of showing how futile it was to undertake to build cars for popular consumption during the early stages of the art, it is only necessary to reiterate the story, setting it to different music. The pioneers of the automobile business started out with the idea of emancipating the working strata of the human race, but it was academic emancipation, as history plainly shows, and in the struggle that followed, the trend of the automobile industry was in the direction of the supply of the highest attainment of workmanship for the benefit of those who could afford to pay an extravagant price, leaving it for the future to build the automobile of popular conception, and make it worthy of its hire.

Pioneers, especially the inventors among them, were frightfully disappointed, thinking, as they did, that the main idea was sidetracked for no better purpose than to serve the rich to the high disregard of the poor; but time again proved to be the best teacher, and the rich man found himself taking the brunt of the disorder, and paying for the experiments that paraded in front of longing eyes, thus furnishing experience, leading up to the final building of the good automobiles that are to serve the populace in the long run.

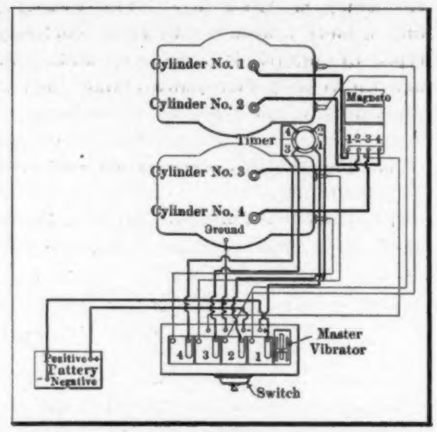


Fig. 5—Wiring diagram of the motor, showing the connections between the unit coil system, the magneto and the spark plugs in the four cylinders, also the battery connections and the location of the switch for the control of the system

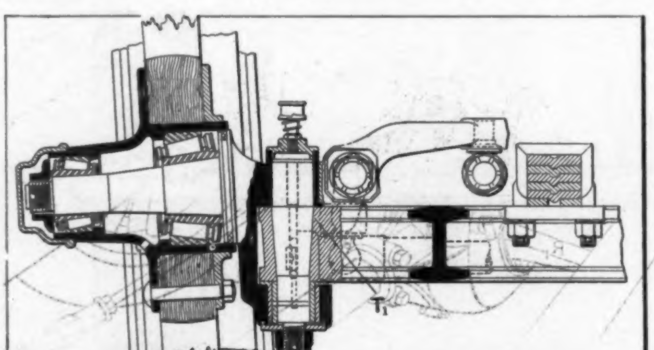


Fig. 7—Section of the front axle at one end, also of a knuckle and a front wheel, showing the method of fastening the knuckle pin and the shape of the forging of the axle

No writer has ever succeeded in getting the buyers of automobiles to understand that there is a difference between static and kinetic work, but if the public has proven to be peculiarly obtuse in this regard it was not more conspicuous than the fabricators of steel, among whom, it may be said, the materials for a locomotive were looked upon as the highest attainment in the steel art. But when the representatives of the steel mill were induced to call upon the makers of automobiles for the purpose of displaying their wares, their willingness to discuss the price on a "jewelry" basis far exceeded the promise of the material that they delivered for the actual work to be done. The literature of the day bearing upon the fabrics in metal, of which the supply of good product was only too scant, was a false literature in that it had its academic side, and the picture that the salesman painted of the actual material furnished substantiated the academic situation from a purely picture point of view; but the practical results obtained from the material were responsible for a large number of automobiles that are now resting in peace in devious scrap piles not far from the homes of the rich men who so bravely supported a new art.

Nature seems to have a happy way of placing the burden on the stoutest stump, and it was a good thing for the automobile business that Nature interfered with the inventors of a few years ago and transferred the burden of proof to the shoulders of time and the men who could afford to pay for the experiments that culminated in the splendid types of automobiles that are now to be had for the asking.

Improvement is Still Going On and the Impossibilities of Yesterday are the Realities of To-day, Making the Refinements of To-morrow.

Continuing the thought that the word "emancipation" suggests, it is apparent that the builder of automobiles must first be put in a position to enjoy freedom before it will be possible for him to pass this blessing on to the users of automobiles. In the process of emancipating, the makers of cars have had to contend (a) with an adverse machine tool problem, (b) with the personal equation involving shop labor, (c) the ego of the idealist, and (d) poor steel.

Machine tools have been revised, and they stand upon a level to-day that is all that the situation might reasonably demand. The problems of labor are being worked out to the exclusion of the type of workman who persists in being a little of everything and not much of anything, ending in the growing up of a class of specialists, each of whom is capable of doing the work

for which he has a bent. The idealist with his ego is verging into a mere tradition. Inferior steel now finds its way into the types of automobiles that are looked upon as non-progressive, and the time is fast approaching when automobiles may be had, utilizing the finest grades of steel at no greater cost than the price of the antiquated products that indelibly mark the incompetent builder whose reputation will fade out accordingly in the course of time.

The latest evidence of specific advances in the production of steel comes from abroad, and has for its foundation the fact that 3 1-2 per cent. nickel billets are to be had at 3.84 cents per pound. Allowing 1.65 cents per pound for finishing, which includes annealing, not forgetting the import duty of 1.2 cents per pound, the price of bar stock f. o. b. New York falls well inside of 7 cents per pound. The billet price is, of course, the most attractive, and it means that the finest grades of nickel steel for kinetic work in the automobile art are at the disposal of the makers of automobiles who are equipped to handle billets at less than half of the cost of the best steel that could be had even three or four years ago.

Looking at the steel problem from another point of view, it is pointed out that the finest grades of electro-steel in billets may be had at slightly over $40 per ton, and the improvements wrought in the fabrication of steel, due to the coming of the electro process, permits of the statement that alloying is at no greater cost than the base price plus the cost of the alloys actually used, and, as a broad proposition, the alloy steel costing as high as 30 cents per pound five years ago may now be had by a keen purchaser at a price which does not necessarily exceed 8 cents per pound.

True, these quotations are based upon steel as fabricated in Germany, to which has been added duty and transportation, however, so that the makers of automobiles in this country are in a position to tell the fabricators of steel in America how much they are willing to pay for standard grades of product. But there is no basis of argument in this phase of the proposition. The price in Germany is invariably the price in America, and the point is here being made that the automobile industry has energized the steel business, and induced the changes that were essential to the increasing of quality manifold, concomitant with the reduction in the cost of production.

In tracing the trend of the industry, it is in these broad considerations that we find ample evidence of the fact that the cars of yesterday were mere experiments to be tried upon the dog, and the cars of to-day have the quality that is essential to success, but the cars of to-morrow will retain this quality in the face of a price that will be low enough to justify the dweller in a cottage in taking money out of a savings bank and putting it into a car.

The Automobile Industry Has Never Drawn Funds From Savings Banks, Hence Its Ultimate Growth is as Yet to be Written in History.

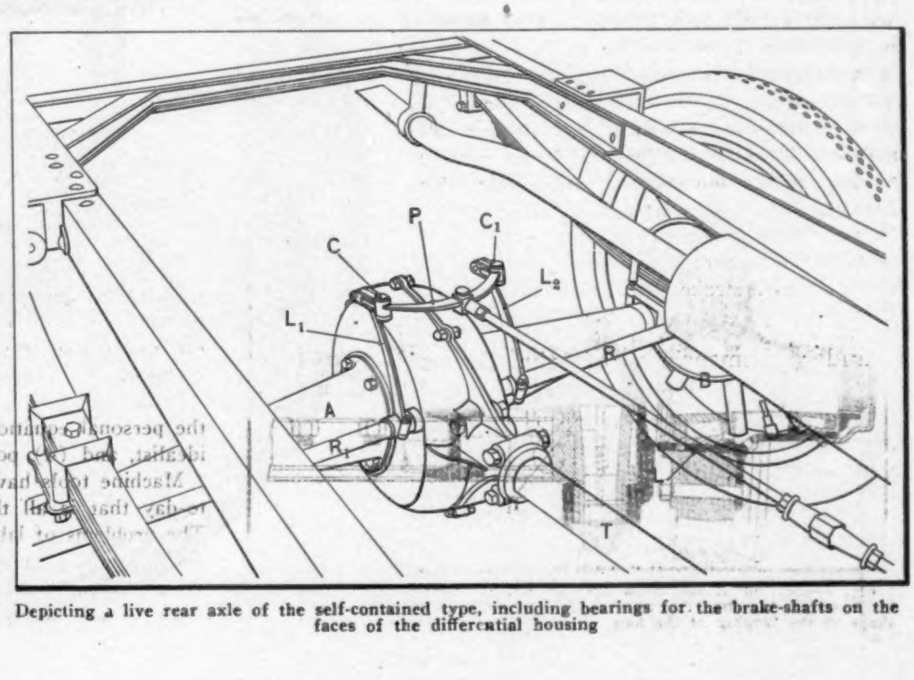
Granting that there are 480,000 automobiles in actual use in America at the present time, it is another way for saying that there are 480,000 citizens who are capable of supporting a checking account in commercial banks, and in estimating the future of the automobile business notice must be taken of the men who have the funds in hand or locked up in savings banks where it pays from 3 1-2 to 4 per cent., and it is only a matter of time when these citizens will be enabled to observe that a certain part of this type of money will bring more than 4 per cent. if they invest in suitably contrived automobiles, and use them in their every-day work.

Mechanics Are Thinking of Advances

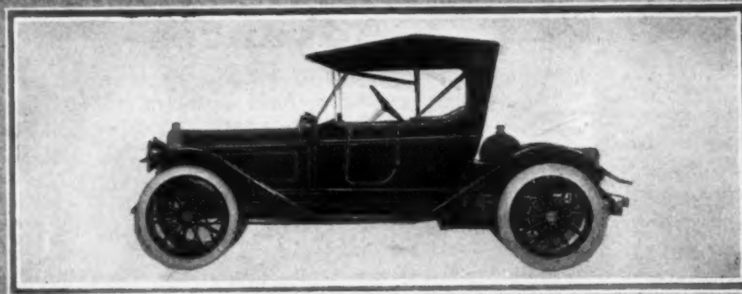
Stagnation is the property of a pool with little in common between it and mechanics of the advanced school, as the illustration of the live rear axle below presented will show. In this example is depicted a new way of hanging the brake-shafts. The idea is well worth perpetuating.

PROGRESS marches a certain number of miles per day. Silence reigns in its ranks. The man who goes along with his head down may not notice that things are happening right along. The fact remains that the designing of automobiles represents great possibilities and it is worthy of note that some of the good selections of these things are being put into circulation. Referring to the illustration of a live rear axle, and particularly to the method of hanging the brake-shafts R and R_1, it will be seen that they extend across from the support at the brakes to the differential housing, the enlargement of which occupies the space between the two axle tubes A with an extension to accommodate the torsion tube T, within which the propeller shaft is placed, the tube being in the concentric relation. The brake-shafts terminate in bearings that are in the form of bushings pressed into bored-out bosses located on the sides of the housings. Arms L_1 and L_2, fastened to the shafts, terminate in universal equalizer shackles C and C_1, to which is fastened the equalizer yoke P. This yoke takes the pull of the main brake-rod L and distributes the pull to the respective arms in such a way that the brakes are actuated equitably. The design is neat; straight-line pulls come on the members, except the torsional parts, and the self-contained principle holds throughout the construction. This design also has the advantage of keeping the axle parts away from the chassis frame, thus permitting the maker of the axle to do all of the work for which his plant should be fitted out to accomplish on a basis of the utmost economy.

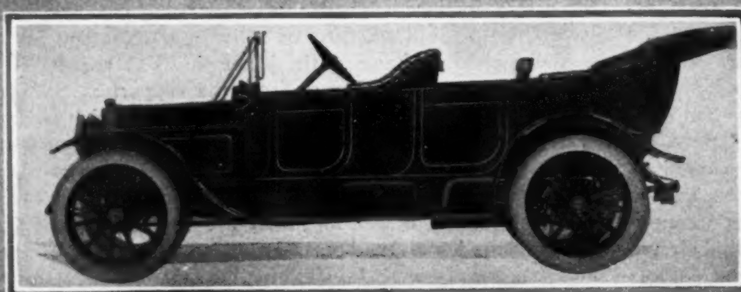
Good Roads in Western Canada—There is not a finer drive in all of Canada than the roads found in Manitoulin Island, which lies at the head of the Georgian Bay. These highways stretch over hundred of miles. And yet there is not a single automobile on the island, nor is there a tram-car line or a railway. But it is timely to say that the denizens of the island are by no means happy over the existing conditions of transit and are seeking a means by which automobiles may be introduced into Nanitoulin Island.



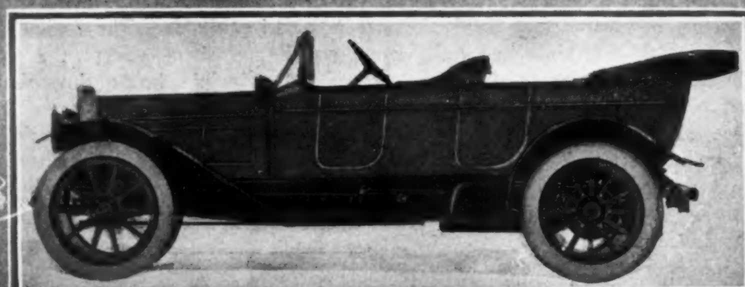
Depicting a live rear axle of the self-contained type, including bearings for the brake-shafts on the faces of the differential housing



A—38 H. P. Six-Cylinder Three-Passenger Roadster



B—40 H. P. Four-Cylinder Seven-Passenger Touring Car



C—38 H. P. Six-Cylinder Four-Passenger Torpedo

1912 Peerless

Illustrations of the

Illustrating some of the advance types of bodies that are in vogue at the Peerless plant, also showing a characteristic chassis of this make, and giving information of a more or less general character apropos of the several models of these cars.

PEERLESS automobiles for 1912 comprise three six-cylinder types and two four-cylinder models of passenger automobiles. The six-cylinder models are rated at 38, 48, and 60 horsepower respectively. The four-cylinder models are rated at 26 and 40 horsepower respectively. Referring to the details of the motors with specific reference to the bore and stroke, the information as follows holds:

Cylinder Dimensions of the Several Models

	38 H.P. Six.	48 H.P. Six.	60 H.P. Six.	26 H.P. Four.	40 H.P. Four.
Bore	4	4½	5	4	5
Stroke	5½	6	7	4⅝	5½
Cylinders	6	6	6	4	4

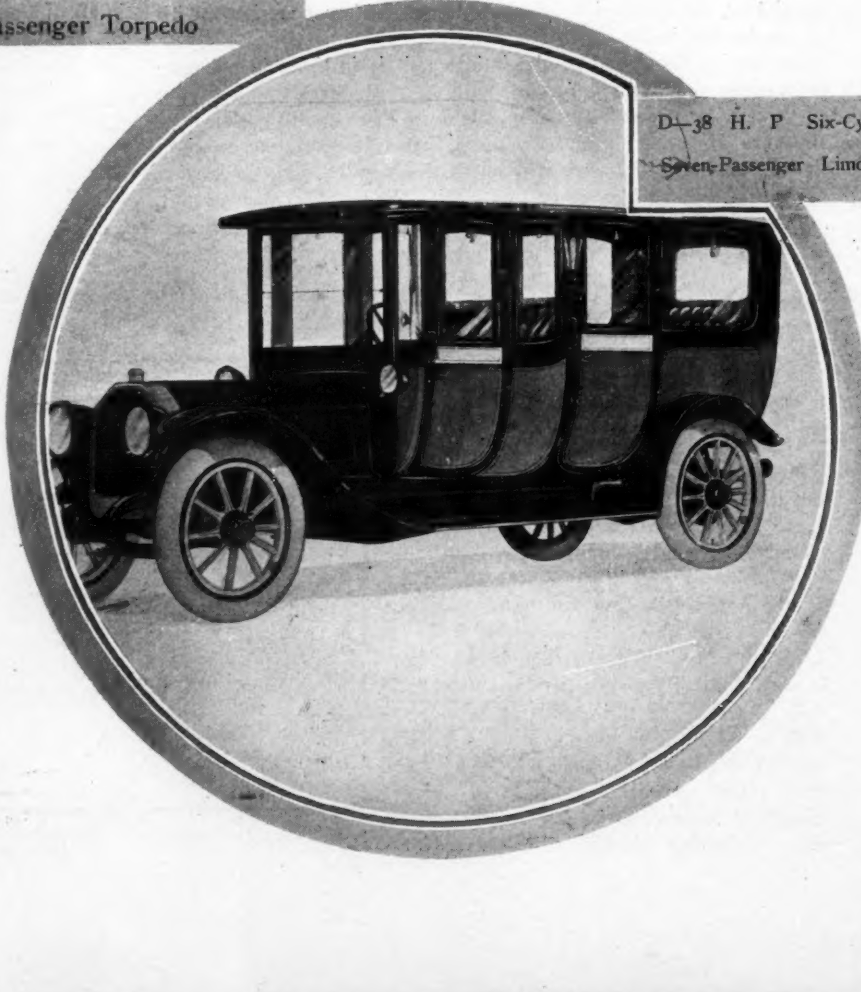
These motors are used on chassis with dimensions as follows:

	38 H.P. Six.	48 H.P. Six.	60 H.P. Six.	26 H.P. Four.	40 H.P. Four.
Wheel base	125	137	140	113	125
Tires, front	36x4½	36x4½	37x5	34x4½	36x4½
Tires, rear	36x4½	37x5	38x5½	34x4½	37x5

It will be seen from a study of the tire equipment that an attempt is being made to economize in the cost of tire maintenance. The sizes of tires used on the rear wheels of the more pretentious models are of greater diameter and section than the tires used on the front wheels of the same models. In addition to affording more substantial tires to interpret the torque of the motor, and stand the tangential strains, the larger diameter rear wheels have the effect of trimming the chassis so that it will be slightly down in front, thus compensating for the effect of loading of the tonneau, and saving the automobiles from the "down in the heels" appearance that is so conspicuously undesirable in work of this character.

Comparing the 1912 with the Models of Last Year

The two four-cylinder motors are in substantial conformity with the 1911 motors of the corresponding sizes. In the six-cylinder motors, the crankshafts are supported on seven main bearings with the crankshafts in two pieces and the crankcases split



D—38 H. P. Six-Cylinder Seven-Passenger Limousine

is Now Ready

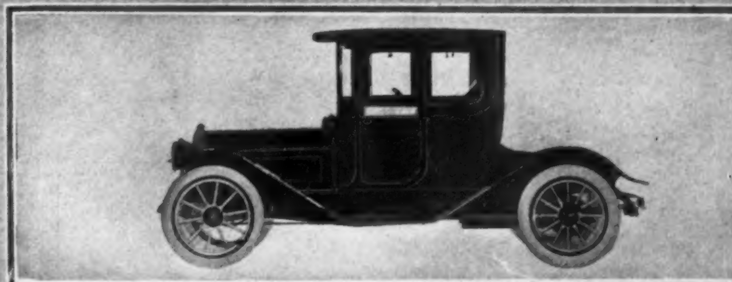
Body Types in Vogue

horizontally through the motor axes. The suspension for the motors at the front end is by means of a drop-forged I-beam to the side bars.

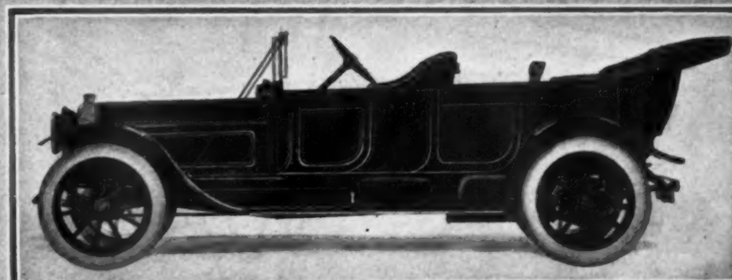
Lubrication of the motors is by the splash system, oil being fed to the crankcase compartments by an oil pump, gear-driven from the crankshaft. Oil is transmitted to the bearings to be lubricated through grooves from a system of pockets aided by headers between each bearing, as well as by cups on either side of all connecting rods.

The motors being of the four-cycle water-cooled type are kept cool by circulating water, using a gear-driven pump located on the left side of the motor, immediately to the rear of the supporting arm. Radiators are of the horizontal tube and fin type, the same as on previous models. Ignition is by Bosch double synchronized system.

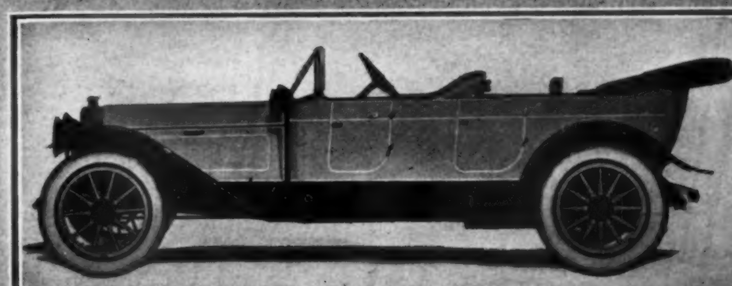
A centrifugal governor of the company's make is employed, and is located on the right side of the motor, immediately to the rear of the front arm. The magneto is driven by the governor shaft.



F—38 H. P. Six-Cylinder Three-Passenger Coupé

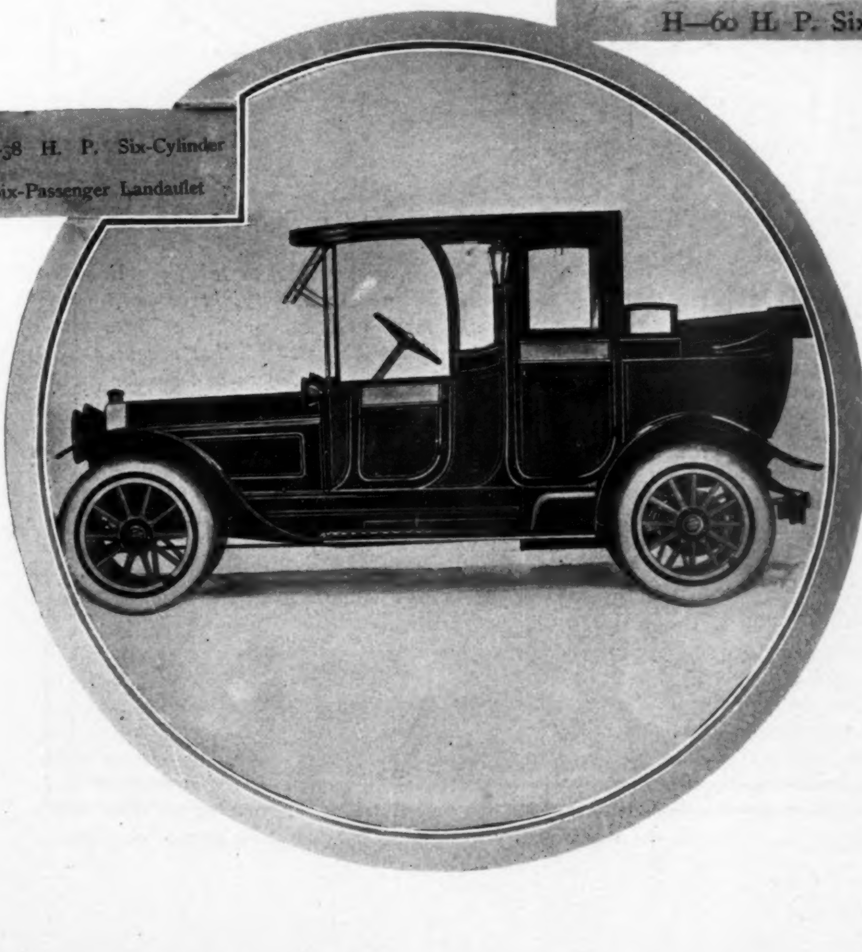


G—48 H. P. Six-Cylinder Seven-Passenger Touring Car



H—60 H. P. Six-Cylinder Six-Passenger Torpedo

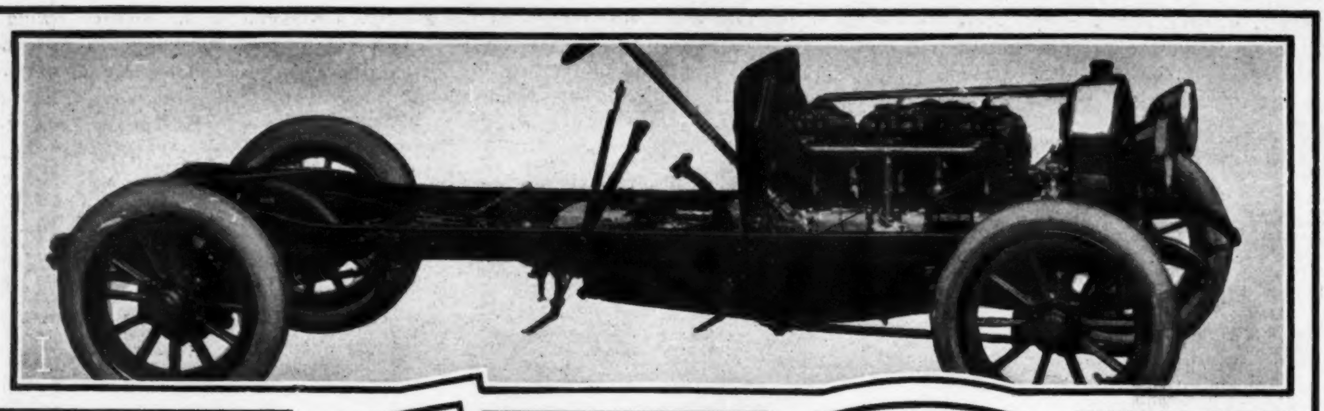
E—38 H. P. Six-Cylinder Six-Passenger Landaulet

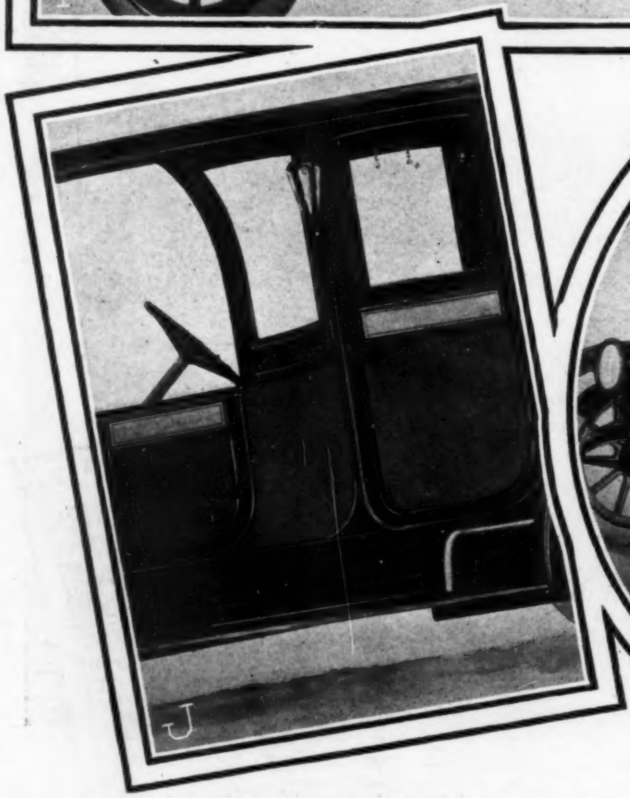


The carbureter is of the new Peerless equalizing type, with a balanced throttle, utilizing primary and secondary auxiliary air valves. Screens are placed in all air intakes. Control is on the dash, actuating damper valves. In starting the motor a priming pump is used. It is actuated by a handle at the front end of the chassis. The priming pump valve lever is located on the dash, immediately below the carbureter air valve lever. This arrangement is found to be a convenience. The manifolds, and other piping, are simple and straight.

Lighting is by the Gray & Davis dynamo on all models. The dynamo is mounted on an aluminum pad, supported from the crankcase, on the forward left hand side of the motor, and driven by means of a laminated lever belt from a pulley on the shaft. For convenience in control of the lighting system the devices include an ampere meter, automatic electric cut-out, junction box, and control switch. These devices comprise a set and are located on the dash. The appearance of the dash is maintained on a basis of art by so shaping the instruments that they are flush with the dash.

A four-cylinder mechanical tire pump is standard on all models, and is direct driven by means of a jaw clutch from the front end of the speed-case countershaft.





I—48 H. P. six-cylinder Peerless chassis—intake side. J—48 H. P. six-cylinder, seven-passenger limousine. K—38 H. P. six-cylinder, three-passenger coupé

The expanding band clutch, characteristic of Peerless designing, is continued. It is pointed out that cork inserts are used, occupying about 33 per cent., of the total area, inserted in a fabric of chrome tan leather.

The transmission case is suspended from a sub-frame and is located amidship. The general construction of the transmission is along well known lines for this product; four speeds forward and reverse are used in all cases; control is by one lever.

The rear axle is of the full-floating type with camber, permitting of the arched construction.

The spring suspension is of the semi-elliptic type in front, and the rear suspension is of the full platform type, comprising two semi-elliptic side and one cross member; this plan is common to all models.

Right hand drive is regarded as standard. All six-cylinder models can be furnished in left hand drive and control.

PRAGUE, BOHEMIA, has 200 automobiles, practically all made in Europe. There is room for many more motor cars and the disposition of the people seems to be in the direction of augmenting the supply, as shown by the favorable reception given the machine and the dexterity in which the local inhabitants are swinging into line and acquiring possession of motor cars. They appear to prefer automobiles which are made in Germany.

How to Sell Cars in Holland

The Dutch, like the Missourians, refuse to take anything for granted. They will not buy anything "sight unseen," much less automobiles, and insist upon seeing the car driven and tested. From which it will be gathered that a selling system which is based solely upon catalogues and similar literature will never prove profitable in the Lowlands.

THE Hollander has heretofore shown a disposition to look unfavorably upon American-made machines, even when samples were brought over by salesmen, their excuse having been that the automobiles were too lightly constructed, which gave them the appearance of being cheaply and flimsily made. But the Hollander may yet take to the American-made car of light and cheap construction, after he shall have been educated up to it. The ships fetch over from America bales of catalogues, letters and price-lists—printed in English—soliciting orders for a dozen or more kinds of cars in the same breath. The Hollander makes a systematic practice of dumping this sort of literature into the fire. He is severely averse to buying automobiles "out of sight and unseen." He wants to see the sample driven and tested. Besides, Germany, France and Belgium are just at his door step, and the manufacturers of these nations show themselves agree-

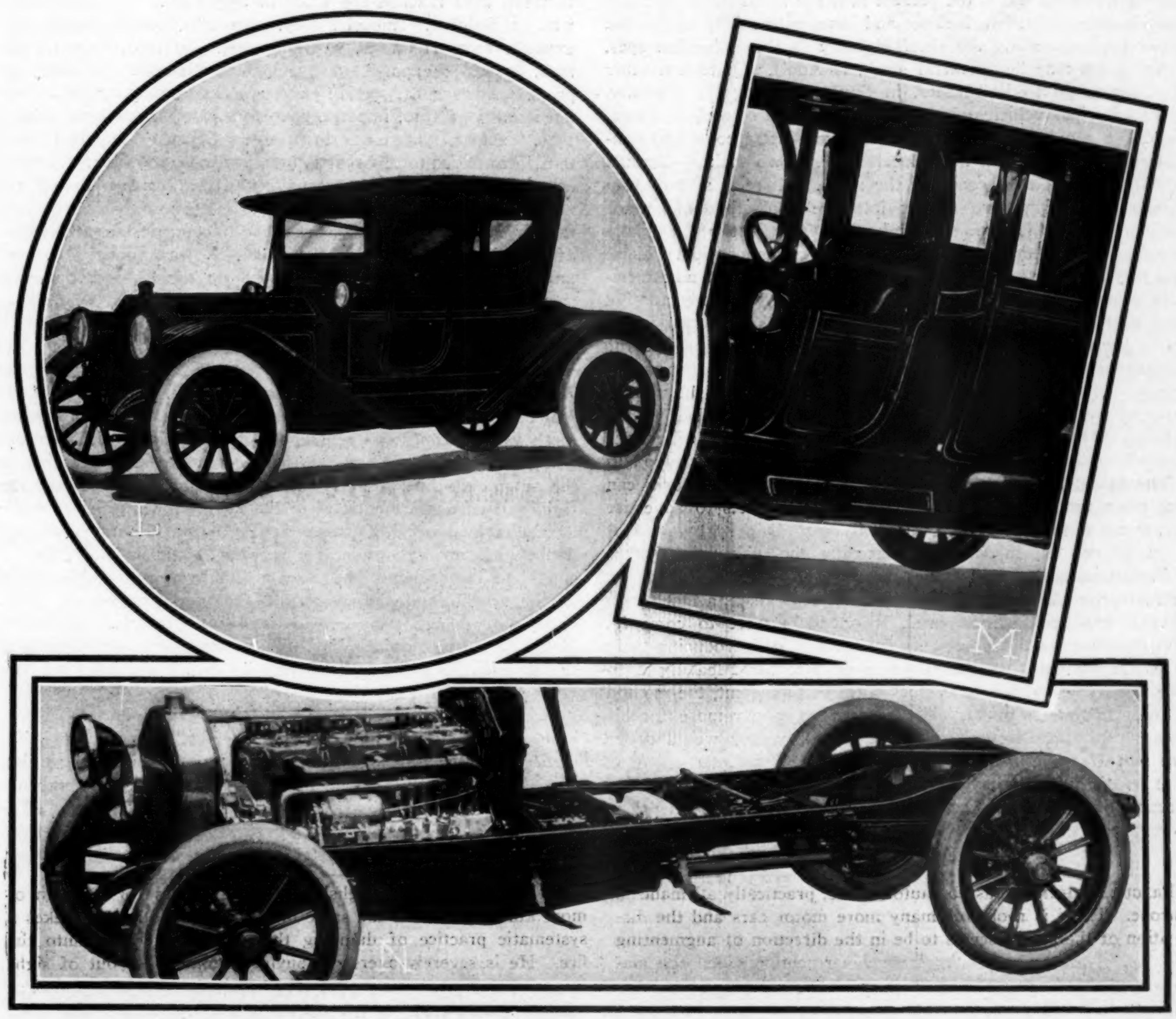
able and accommodating in the matter of credits in the sale and purchase of automobiles. This system of credits is the Hollander's heritage and he does not feel disposed to make any exception in the case of the American manufacturer. To do business in Holland the manufacturer must establish a European agency.

Russia and the Motor Car

Indicating some of the reasons why the automobile is not more popular in the Czar's dominions, and setting forth what must be done by those who contemplate establishing a trade there. The Muscovites seem to be especially impressed with the electric, and the possibilities along that line are well worth looking into.

RUSSIA presents a great many difficulties in the way of developing the automobile industry at the present moment. Moscow, whose population is 1,360,000, has no electric automobiles, and a total of only 720 automobiles whose propelling power is gasoline—an astonishing fact when the city is compared with Paris, where there are 18,000 motor cars to the 3,000,000 inhabitants. Here are some of the reasons why Russia does not make a better showing in the automobile industry: long distances; inadequate means of communication; insufficient railway lines; the unsuitability of the gasoline automobile in the country, owing to the scarcity of even half-way competent chauffeurs and their inability to make repairs. Russia needs a motor car simply constructed, so that anybody may be able to drive it, and accommodations for making repairs, in the event of breakdowns. Some Russians assert that the electric motor car would be the most suitable, provided that it was not too expensive and possessed the durability to run over Russia's characteristically bad highways. Besides, its upkeep would need to be low. There is a feeling of friendliness toward electric motor cars, particularly in Moscow. But it is no use to try to sell machines on the strength of catalogues, because no one in Russia will order an automobile, especially an electric one, without having previously seen it. The demonstration of electric passenger motor cars on the streets is the proper means through which to make sales. Every car should be accompanied by all required accessories for recharging the batteries, and by the most precise instructions, printed not alone in the Russian, but in the German language.

British Exports Increase.—The United Kingdom exported motor cars, chassis and parts during January and February of this year to the value of $2,532,171, better by 190 per cent., or $1,659,837, than in January and February of 1909, and 72 per cent., or $1,061,077, in excess for the same two months of 1910.



L—38 H. P. six-cylinder, three-passenger Peerless roadster. M—38 H. P. six-cylinder, six-passenger limousine. N—48 H. P. six-cylinder Peerless chassis—exhaust side

Revelations Regarding Rubber

Concerning Its Production and the World's Tire Markets

From the reports of our consuls in the various countries where rubber and its manufactures form a considerable item of trade the following information has been gathered. It is evident that the rapid growth of the automobile trade has quickened activity in rubber everywhere, and in every country where the climatic conditions are favorable to its production efforts are making to establish plantations.

UNTIL the year 1908 the rubber tire sales in certain parts of Germany—Markenkirchen, for example—had amounted to very little outside of those needed for bicycles. But the growth of the automobile industry has quickened the demand for rubber tires, and at the present time the shops in this vicinity are liberally stocked with shoes and inner tubes. The last of the German towns along the chief highway to the Bohemian spas, where tires may be found in stock, is Adolf. Quite a number of tourists go to Bad-Elster, in Saxony, during the Summer, their principal vehicle of travel being the automobile. Therefore, the shopkeepers in Adolph and Bad-Elster command considerably more than a mere local trade. Two makes—German and French—of tires comprise the stock. There is a third firm which is striving hard to get into the field, the amount of money which this firm spends having the effect of gradually prying open the door to admit its goods to competition. There are bicycle tires sold here which are manufactured by an American concern and which supplies, by the way, the only foreign tire sold in this locality. The firm maintains a branch house in a German city and assigns salesmen—who can speak the tongue of the people—to various parts of the Empire to solicit trade. If American manufacturers would successfully compete in the German market they must needs establish branch houses in Germany from which to assign salesmen. The antiquated catalogue system of exploiting goods is looked upon in Germany as being nothing short of idiotic. But no harm can come—in fact, it pays—if the manufacturer elects to advertise his wares in the German newspapers.

In Barmen and in Elberfeld, Germany, the rubber tire field is still undeveloped. This applies to tires for all sorts of vehicles. Tires for automobiles are manufactured in Barmen, a fact which would make competition brisk if outsiders were to come in. While American manufacturers have a way of introducing their tires through an agent in Bremen or Hamburg, leaving it to the retail trade to purchase stock through this agent, the method is not popular, as it compels the customer to pay more for his tires. A branch factory or an accredited agency would prove the more feasible in the end.

There is but a limited market for rubber tires in the Shanghai section of China. Only a small class of the natives can afford to purchase even so cheap a vehicle as a bicycle. An infinitesimal quantity of these tires come from America, the bulk of the goods consumed being imported by China from France and Great Britain. Agents sent over by firms from these countries are continuously on the ground endeavoring to rubber-tire every wheel in sight, their energy extending even to the jinrikisha. Gradually the old iron tire is going the way of the Celestial's heretofore prized long queue. France gets the greater share of the business there. But in those parts, as in other sections of the old world, as well as in the new, it is the-man-on-the-job who secures the trade. Circulars and catalogues are regarded in China as a joke—for even the outwardly bland Celestial is "from Missouri and he wants to see the goods." The one alternative, provided that a firm does not deem it advisable from a profit-making standpoint to send an accredited agent, is to authorize a local firm to establish an agency for the sale of the manufacturer's goods. Any attempt to build up or control the business from the home factory, or office, is suicidal. Liberal displays of wares and a willingness to conform to the local rule of giving from fifteen to ninety days' credit, as observed in European countries, are indispensable requisites to a successful trade campaign.

Italy's automobile pneumatic tire importations during the last four years have amounted to $5,164,883. Her exports of manufactured tires reached the value of $5,302,878. The distribution was as follows: Imports, 1907, 27.9 tons, valued at $86,155; exports, 1907, 11.3 tons, worth $34,894. In 1908, imports, 64.2 tons, $179,664; exports, 1908, 291 tons, $815,483. In 1909, imports, 492.9 tons, $1,379,381; exports, 456.1 tons, $1,276,396. First ten months of 1910, imports, 792.9 tons, $3,519,683; same period, 1910, exports, 715 tons, $3,176,105. Germany supplied 300.5 tons, France 220 tons, Great Britain 202 tons, and other countries 69.5 tons of the tires imported into Italy during the first ten months of 1910. Italy furnishes no exception to the rule obtaining in other Continental European countries in the matter of affording opportunities for trade—the firm desiring to sell must have a personal representative on the ground, one who speaks the language and who is familiar with (and who shows respect for) the customs of the people. Competition is swift, and at the same time Italy's people are rapidly becoming the owners of more automobiles. There is a chance here for the American manufacturer of automobile tires, provided that he will do as the Italian does. Besides, Rome's and Turin's mammoth world expositions scheduled for the coming Summer are going to result in packing together a great many competitors in the automobile line. The American manufacturer who puts the right sort of a representative in the field, allowing him to make a creditable display of wares in Turin and Rome, would no doubt pick up a considerable amount of business. Italy, it should be remembered, has some of the finest automobile roads in the world, and the hearts of their makers are in them. Fancy a road built 312 years B. C. and still in prime condition! Yet such is the Appian Way. There are many other roads in the kingdom of Victor Emmanuel III which are very old and very good at the same time.

Japan affords scarcely any market for rubber automobile or carriage tires. There is, however, a growing demand for jinrikisha and bicycle tires. In this respect, as in her warships, Japan is struggling to be up to date—showing that although not an originator or an inventor she is a splendid imitator. The British practically control the tire trade. But the American manufacturer who would establish a branch factory in Japan, or appoint a local agent, could get some of the trade.

The native gums of North British Borneo have taken on a new estimate of value, particularly rubber, gutta-jangkar, gutta-jelatong and gutta-percha. A British concern appealed to the Rajah in 1909, who granted the company a concession to control the product of the forest of Sarawak. Extensive refining works were erected at the mouth of the Sarawak River, a distance of eighteen miles from Kutching.

Abbreviated Injunctions

Aphorisms, apropos of the automobile, of seasonable portent, with a utility side for the man who looks twice.

DON'T let a frolicsome chauffeur toy with a high-priced machine.

DON'T look with a judicial eye on a stretched repair-bill after it is rendered—appeal to the repairman's reason before he starts work.

DON'T let the salesman take up your time with pleasantries instead of telling you what kind of a car you are to get from him.

DON'T lavish profuse apologies on the adjuster or the tire-maker when you call upon him with your claim.

DON'T entertain the plenipotentiary for a junk-pile if you want to buy an automobile.

DON'T yield to the whim of the romantic salesman who would fasten a 20-inch searchlight on a doctor's rig.

DON'T be satisfied with the exterior appearance of the automobile that attracts your notice; have a look in the *peritoneum*.

DON'T omit plying the salesman with questions to bring out detail when he relates the skeleton of a grand plan—a certain danger resides in skeletons.

DON'T listen to a learned discourse if the raconteur fails to adhere to the subject.

DON'T go in for the antique in purchasing accessories for a new automobile.

DON'T labor under the impression that an antiquated lamp will keep you from running into an obstruction on the roadway just beyond the next turn.

DON'T say that you are unlucky if you drive at a high rate of speed and unceremoniously drop into some farmer's orchard.

DON'T imagine that it is "Paradise" to drive at a terrific pace—Paradise is in another county.

DON'T have a foreboding that an accident will befall you before the day is over and then drive with the speed of the wind in quest of it.

DON'T presume too much on the strength of your automobile; even if you avoid an accident, the life of the car will be unduly shortened if you cover too much ground.

DON'T assume that the rules of the road are wholly arbitrary; this condition lies in the imagination of the road hog.

DON'T adapt arbitration as a religion and try to palm it off on the very next contending policeman—he will get you if you do.

DON'T litter up the "archives" of your automobile with an ineffectual set of brains.

DON'T inflict an imposing series of short talks on your neighbor bearing upon the fine qualities of your automobile, and then sell it to him for twice as much as it is worth.

DON'T lament if you blindly purchase a second-hand automobile and then discover that it is not worth a tinker's dam.

DON'T join the constellation that pays good money for second-hand tires and expect thereafter to present the brilliant spectacle of the milky way.

DON'T labor under the hallucination that you have a divine right to the middle of the road, and that farmers have to run along in the gutter.

DON'T accept the inexplicit in making a bargain with your dealer—if he is under the handicap of uttering double-meaning English introduce him to a lawyer.

DON'T entertain the indefatigable little noise that creeps into your automobile—drive him out.

DON'T take a recess upon coming home off a muddy road—wash the automobile before you put it away.

DON'T think that you are listening to a "minister of justice" while your ear is cocked to the sayings of the fellow who is attempting to get rid of some old accessories.

DON'T accept the proprietorship of a fallacy.

DON'T allow yourself to be robbed by the chap who sports an infant's smile.

DON'T be irresolute—you cannot get a good automobile by that route.

DON'T forget that silence is taught in the best school of diplomacy; the best type of automobile is a finished diplomat.

DON'T associate with an old iniquity if it has four wheels and bears the earmarks of the Battle of the Wilderness.

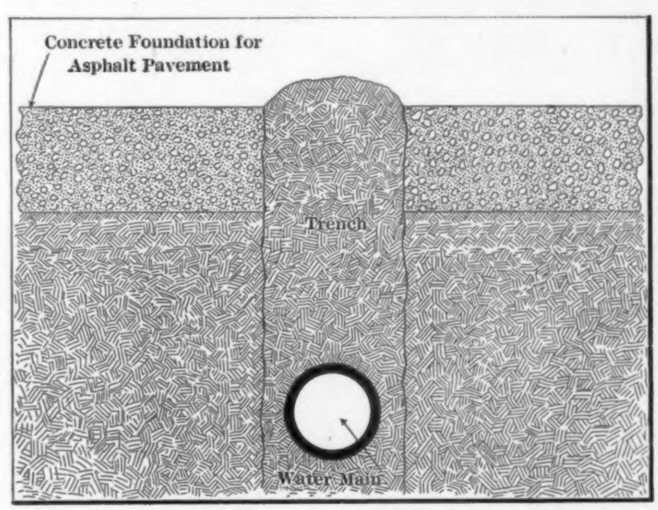
DON'T let the second-hand man dub you a "Scotch Innocent"—it is like wearing the coffin of a fool.

DON'T employ all the arts of rhetoric in your attempt to tell the dealer how anxious you are to get rid of your money.

Lack of System in Fixing Streets

Presenting a concrete illustration of the well-thought-out plan which results in the dissipation of a large amount of the public funds, and a poor showing from the pavement point of view.

THE illustration in this article is of Fourteenth avenue, at the corner of Bay Ridge avenue, in the Borough of Brooklyn, showing the concrete which was put down after Fourteenth avenue was graded, but before the concrete was set the water department came along and dug it up in order to lay a water main on Bay Ridge avenue. After the water main was put down and the trench was filled loosely, no attempt being made to tamp the earth into the trench, the broken stone was laid back in the top of the trench, and there the matter rests. The fact that this avenue was to be asphalt-paved was well known for a long time, but no attempt was made to lay the water main until after the pavement contractor put down the concrete. It is self-evident that one of two things must happen, either the contractor will have to be reimbursed for the cost of putting new concrete into this trench, or the asphaltum will be laid over the trench with the concrete foundation resting as the materials were thrown loosely into the trench by the men who put down the water main. A little later on automobiles will probably have occasion to complain of the depression in the pavement at this point, and the city official whose hindsight is the most conspicuous part of him, if he is honest, will have forgotten the circumstances. It would scarcely be worth relating this situation excepting in the hope that the administration will look into the circumstances and recommend measures that will permit the pavement to rest in peace after it is put down.



Section of Fourteenth Avenue, Brooklyn, showing a mutilated foundation of the asphalt pavement that is being laid

A—How Endicott protects his eyes
B—Bruce-Brown wears a headgear with goggles
C—Bob Burman realizes the necessity of facial protection.
D—Wishart protects his eyes and face in an unpretentious way
E—Howard Hall relies upon a good set of goggles
F—Charlie Merz uses distinctive eye protectors
G—Charles Bigelow sports an atrocious leather headgear
H—Arthur Gibbons wears plain goggles

Eye Trouble Due

A French Writer Relates

Frances G. Wickware translates a story from the French, dealing with the character of eye trouble that is normal to the use of tar for road building. It would seem, from the story, that vapor of tar is difficult to exclude by means of goggles, although there is virtue in the use of a good set of eye protectors. It would appear that raw tar is the greatest offender, and properly contrived road building is desirable under the circumstances

DISEASES of the eye among drivers of automobiles, directly attributable to the action of the dust of tarred roads, have become sufficiently serious and common in France to attract the attention of medical investigators. They first made their appearance in 1906, among automobilists on the Sarthe circuit which had been treated with tar for nearly the whole of its length. Two years later the subject was brought up at the first International Road Congress, in a report presented by a zealous advocate of tar treatment, who, nevertheless, frankly admitted that tarry vapors from freshly treated roads and particles of tarred dust are liable to cause conjunctivitis or inflammation of the mucous membrane lining the inner surface of the eyelid and covering the eyeball. Another speaker at the same congress reported the presence of large quantities of a blackish, irritating dust in the air of a Paris street treated with westrumite, a solution of tar in ammonia, during periods of heavy traffic. It was suggested by a leading French highway engineer that as the trouble seemed to be limited to drivers racing over a course on which the tar was freshly spread or at least not thoroughly dry, injurious effects would be avoided by the use of suitable goggles. A recent writer in the *Revue Générale des Sciences,* however, shows that, at least in certain cases, eye trouble cannot be avoided in this way. Goggles may be a partial protection against dust but not against vapors, for it would be impossible, and dangerous if it were possible, entirely to close them against ventilation. On freshly tarred roads and during warm weather, and it may be remarked that cases of conjunctivitis among chauffeurs are much more frequent during the Summer months, the vapors arising from the tar are responsible for the greater part of the eye trouble observed.

Two physicians of Montpellier, MM. Truc and Fleig, have made an extended comparative investigation of the injurious effects on the eye of the dusts of ordinary and tarred roads. Samples of dusts secured from various roads were sifted at more or less frequent intervals into the eyes of dogs and rabbits. At first sight this method appears open to criticism, as not reproducing the actual conditions of automobile driving. MM. Truc and Fleig justify it, however, by reference to the difference between the human ocular apparatus and that of the animals experimented with. Dogs and rabbits have a third eyelid, and in general their ocular apparatus is less sensitive than that of man. It would have been impossible, they say, to have produced the characteristic effects of dust on the eye by simply exposing the animals to a current of dust-bearing air. However that may be, the method adopted has given very definite results. The experimenters have found that ordinary road dust, whether the road metal is siliceous or calcareous, causes only a slight inflammation of the eyelids which is readily cured by natural processes. The dust of tarred roads, on the other hand, even when the binder is no longer fresh but the road

to Tarry Vapor

Some Road Difficulties

surface is still in good condition, caused extremely serious conjunctivitis, assuming a purulent form, with chronic inflammation of the lachrymal gland. The most serious cases were observed when, instead of surface dust, samples of pulverized road surfacing were used in the experiments. These samples naturally contained more tar than the surface dust.

It is not possible to accept the theory that mechanical irritation alone is responsible for the effects observed in these experiments. The cause must be looked for among the complex constituents of the tar, and of these the carbides and the hydro-carbons of the phenol group would appear to be essentially responsible. This deduction is confirmed by clinical observations made among pitch workers, which were communicated to the Industrial Diseases Congress held at Brussels last year by a number of Belgian physicians. Industrially, pitch produced by the distillation of coal tar is of two kinds—the common black pitch, which is rich in phenols, and dry pitch, which contains little of the phenols and hydro-carbides. Pitch workers are constantly exposed to pitch dust, and it is very common to find among them cases of conjunctivitis with more or less serious suppuration, sometimes even producing ectropion, or eversion of the eyelid, which may have most serious results for the cornea. The latter, being no longer protected against dust by the eyelid, is subjected to a bombardment of dust particles which results in a diminution of visual acuity. The action of the phenols in producing these troubles seems to be established by the fact that serious cases are wholly confined to workers in black pitch. The dry pitches, which contain no phenols, involve no specific danger.

The chemical action of the dust of tarred roads is still more strikingly disclosed by a consideration of the fact that the dust of ordinary roads is very rich in micro-organisms, while tar treatment materially reduces their number and even expels bacteria completely, at least when the tar is still fresh, the period when tarred dust is most serious in its effects on the eye. An exhaustive investigation of this point made some years ago led to the conclusion that, from a bacteriological point of view, the air of tarred roads is infinitely better than that of ordinary roads. MM. Truc and Fleig also have made bacteriological investigations, both quantitative and qualitative, of dust samples used in their experiments. They have found that tarring reduces the number of bacteria, but not that it entirely removes all dangerous micro-organisms. As a matter of fact, they have produced tetanus in guinea pigs by inocculation with tarred dust.

Of the many examples of goggles and masks for the protection of the eyes and the face, automobilists are alive to the fact that quite a number of them are more ornamental than useful. Utility and hideousness is also to be had at a price. The real question is to get goggles and head-gear on a utility basis with a sufficiency of adornment to satisfy the unassuming, and it would seem as if a lesson can be taken from the experiences and practices of the drivers of racing automobiles, in view of the fact that they are frequently put to the task of piloting their cars on freshly oiled tracks. The illustrations as here afforded show a variety of the head-gear used by the most famous racing drivers of the present time, and a little ingenuity coupled with the best selections of these practices, should result in the type of eye protection that will be efficacious under exacting conditions. The probabilities are that two or three designs of goggles will have to be used by the automobilist who proposes to take care of his eyes, providing for the several conditions obtaining in touring.

I—Bert Adams uses a business-like head rig
J—Fred. W. Ellis relies entirely upon goggles
K—Jagersburger goes in for utility with the goggles
L—Joe Dawson is business-like in his head-dress
M—Turner gets along with goggles unadorned
N—Disbrow and his mechanic use the same idea
O—Anderson wears a well-designed set of goggles
P—Herbert Lytle has a style of his own

Practical Test of a McCord Radiator

A report of a test of a McCord radiator under road conditions, using a Thomas car, showing the method employed in the tuning up of automobiles, in order to be able to determine as to the best size of radiator to use, and to harmonize the conflicting relations by whatever means the working situation would seem to indicate.

START made from factory at 9.15 a. m., with oil and gasoline tank and radiator full. Party composed of:

	Weight.
The driver (Mr. Flanigan)	194 lbs.
Egerton	130 lbs.
Weigold	140 lbs.
Neuteboom	176 lbs.
Coe	135 lbs.
Howe	137 lbs.
Total	912 lbs.

Speed until 10 a. m. approximately 20 miles an hour; then average speed 25. On level the best maximum speed obtained was 47-49 miles an hour.

Previous to starting one gallon of oil was put into crankcase. After 26.5 miles another supply of one-half gallon was given motor.

Wales Center was reached at 10.45. Here the first hill was encountered. About 200 feet up the high gear jumped out, and it was necessary to stop car and block wheels before gear could be shifted. This was due to inability to shift gears with emergency brake on. The second gear was used until near the top, when it was found necessary to use first. The remainder of the hill completed on high, which showed extremely good power. No signs of overheating were noticed.

The second hill was rushed at 25 miles an hour. Dropped into second, and nearly at top when it was found necessary to use low. The radiator was still cool enough to touch, but slight loss of power noted. The high gear again slipped out coming down short hill.

Buffalo Hill. Rushed; dropped into second. About half way up dropped into low and engine speed up to 14 miles an hour to see whether at this speed the engine would heat. No sign of overheating noticed. Car had plenty of reserve power. After peak, second and high, completed the hill. Considering the work done, the radiator was extremely cool and no steam generated.

Down Buffalo Hill the car was held on the emergency brake helped by the foot brake. At the bottom, the brakes were smoking but not very seriously hot.

Stopped for lunch at 11.30 and started for Buffalo at 12.15.

Slight leak noticed at bottom of radiator and half pail of water added. No boiling was noticed on any of the hills or on the road. Arrived at factory at 1.35 p. m.

Added one gallon of oil to crankcase, but no water or gasoline to tanks. Mileage 70.2.

Left for Williamsville at 1.50, and from there took the "Creek Road" to Tonawanda. At 30 miles an hour the high gear jumped out twice. At 84.5 miles struck deep sandy road and drove at speed of 30 miles an hour, which was as fast as safety allowed. Sand from 3 to 4 inches deep. After 4.3 miles of this sand the left rear tire blew out. For the last half mile the radiator commenced boiling and on removing cap boiled over badly. Poor lubrication probably pulled down power of engine more than overheating.

Tire repaired and started for Tonawanda at 3.15, first adding one bucket of water and a quarter gallon of oil. After 2 1-2 miles more of heavy sand and a speed of 30 miles, cap was removed. Violent boiling noticed and engine was stiff. A half bucket of water added, and as supply of oil was exhausted drove easily to Tonawanda, then to Buffalo, arriving at 4.10 o'clock in the afternoon.

During run home engine limbered up to some extent, but still slightly stiff. Small leak noticed on right hand side of radiator, caused by pressure of steam generated.

The gasoline tank was filled again to same level as at start, taking approximately eight gallons.

Total mileage, 104.2.

Miles per one gallon of gasoline, 13.05.

Taking gasoline at \$.20 a gallon, cost of one mile = \$.0153.

Cost per passenger, \$.00255.

Total weight of passengers, 912 pounds.

Extras, 88 pounds.

Total, 1,000 pounds.

Cost of one ton per mile = \$.0306.

From the above run would conclude that for hill work and sand roads at *normal* driving speed the cooling is perfectly efficient.

CHINESE PREFER CLOSED CARS—China likes to have her automobiles closed, after the style of the sedan chairs. This custom also suits the Chinese women, who are not accustomed to appearing in the streets in a vehicle except it is closed.

Calculations Concerning Pistons

Data of Up-to-Date Methods of Piston Design

In the following article the dimensions of pistons and wrist-pins are handled and formulæ that have given satisfaction in practice are given, translated from an article in "La Technique Automobile et Aerienne." Useful information concerning thickness of the face of the piston and the various dimensions of piston rings will be found.

THE pistons of automobile motors have two duties to perform—that of transmitting energy, and, on the other hand, to bear the lateral component forces produced by the connecting rod and thus act as a cross-head.

The following calculations are the means used to find the dimensions of pistons to resist these two strains.

LENGTH OF PISTON.—This must be considered as the piston acts as a cross-head. The pressure of the piston, normally on the surface of the interior of the cylinder should not exceed certain limits. The means of finding this can be calculated from Fig. 1, in which

L_{co} = length of the connecting rod in inches.

R = length of the crank throw.

Pm_{total} = maximum thrust of the piston (maximum pressure of the explosion. Pm in square inches multiplied by

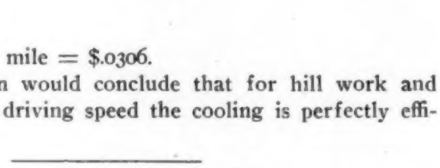


Fig. 1—Diagram to illustrate the pressure of the piston on the interior surface of the cylinder

the surface of the piston in square inches.

$K_{p-total}$ = total lateral pressure exerted by the connecting rod on the piston normally on the lower part of the cylinder surface (normal pressure K_p multiplied by the projection of the cylindrical lateral surfaces of the piston,

D = bore in inches.

L_p = length of piston in inches.

The maximum of $(K_{p-total})$ is a fraction of $(P_{m-total})$ dependent on the ratio $\frac{L_{co}}{R}$.

If $\frac{L_{co}}{R}$ equals 4; $(K_{p-total})$ maximum $= 0.25\ (P_{m-total})$.

If $\frac{L_{co}}{R}$ equals 5; $(K_{p-total})$ maximum $= 0.20\ (P_{m-total})$.

But $(K_{p-total})$ is maximum when the connecting rod and the crank are at right angles; that is to say, about midstroke, and at this moment $(P_{m-total})$ is certainly less than half of its maximum value. This permits one to state that

$(K_{p-total}) = 0.1\ (P_{m-total})$

from which $D \times L_p \times K_p = (K_{p-total}) = 0.1\ P_m \frac{\pi D^2}{4}$; from which follows equation *a*) : $K_p = \frac{0.078\ P_m\ D}{L_p}$. But in practice the relation between the length of the piston L_p and the bore D is : $L_p = 1.14$ D.

It is possible to find the value of L_p because K_p is known. The equation (*a*) indicates the unbalanced pressure K_p to be 17 to 24 pounds per square inch on the lateral surface of the projection of the piston when the maximum pressure of the explosion is between 250 to 350 pounds per square inch.

THICKNESS OF FACE OF PISTON.—The face of the piston can be either flat or curved, but it is usually flat. Strength can be added to the whole by additions of webs, but they do not materially diminish the thickness of the face.

The practical formula for pistons with or without webs,

$T_{pf} = 0.044$ D.

T_{pf} = thickness of the face of the piston.

D = bore.

T_{pf} varies between 1-8 and 1-4 inch in order to take care of good casting and proper cooling. It is not practically possible to calculate the strain exerted on the face of the piston, but if it is considered in the same manner as a plain disc held up on its edges it is possible to apply the Bach formula:

where

T = thickness of the face of the piston in inches.

D = bore in inches.

P_m = maximum pressure of the explosion in pounds per square inch.

$$T_{pf} = 0.45\ D \sqrt{\frac{P_m}{S_b}}$$

S_b = maximum longitudinal strain on the face of the piston in pounds per square inch.

It will be found that as the maximum explosion pressure is between 250 to 350 pounds per square inch, the longitudinal strains will be in the vicinity of 25,000 to 35,000 pounds per square inch, which the casting would certainly not be able to withstand in the manner that it is used.

This method, therefore, is not applicable, especially as the face of the piston is in the form of a plate of limited dimensions and is outside of the limits of the formula.

It is therefore necessary to calculate the face of the piston as if it were a plate subjected to shearing action all around the circumference and withstanding the total maximum pressure of the explosion.

$$\pi D_i \times T_{pf} \times S_s \times P_m \frac{\pi D^2}{4}$$

D = bore in inches.

T_{pf} = thickness of the face of the piston in inches.

S_s = shearing strain in pounds per square inch.

P_m = maximum explosion pressure in pounds per square inch.

D_i = interior diameter of the face of the piston, in inches.

For a maximum pressure of the explosion of 250 to 350 pounds per square inch the shearing strain will be between 1400 to 2400 pounds per square inch.

PISTON WEBS.—They are either two or four. Two are placed in the plane of the traverse of the small end of the connecting rod and two in the perpendicular plane.

The thickness of these webs varies between 1-8 and 1-4 of an inch and as an average from 1-8 to 3-16 of an inch.

THICKNESS OF THE BODY OF THE PISTON—This decreases progressively from the center of the cross-head down to the base of the open end, where it should have a thickness of from 1-8 to 5-32 inch. Under the piston rings the thickness should be 3-16 of an inch.

PISTON RINGS—These are usually eccentric. The exterior diameter D_l of the bridge or of the ring of the bridge in which the rings are fitted is: D = 1.04 D.

D = bore.

Several details of joints and methods of fixing piston rings will be seen by referring to Fig. 2.

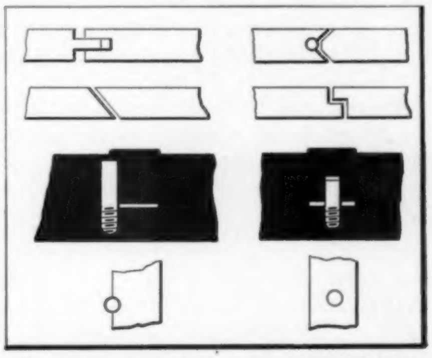


Fig. 2—Showing different methods employed in the splitting of piston rings; also some methods of maintaining them in place

Four rings are usually employed and the thickness of these is 1-4 inch. The maximum thickness T_r maximum of the eccentric ring is

$T_{r\ max} = 0.04\ D + 0.01''$ (D = bore)

If a constant tension is desired in the piston ring at the same time as a constant pressure on the interior surface of the cylinder, theory demands that the thickness must be maximum at the point opposite to the joint and nil at the joint.

In practice one obtains

$T_{r\ min} = 0.637\ (T_{r\ max})$

The rings are usually spaced 3-16 inch from the edge of the next one between the face of the piston and the vicinity of the cross-head of the connecting rod.

The slots to accommodate the piston rings have a depth of from 5-32 to 1-4 of an inch.

The following formula serves for these slots:

$S_d = 0.75\ (T_{r\ max})\ 0.0875''$

S_d = depth of the slot in inches.

$T_{r\ max}$ = maximum thickness of the ring in inches.

The width of the slot should be 0.001" larger than that of the ring.

DIAMETRICAL PLAY OF THE PISTON—This play should be greater on the closed side than on the open ends for heat considerations.

Play on the closed side: 0.00174 D" (D = bore).

Play on the open side: 0.0001 D".

WEIGHT OF THE PISTON.—$W_p = 2.06\ D - 4.43$ pounds.

W_p being the weight of the piston in pounds.

D bore in inches.

WRIST PIN.—This is usually hollow for reason of lightness. It should

1. Have sufficient rigidity.
2. Be capable of withstanding a reasonably unbalanced normal pressure on the exterior lateral surfaces.

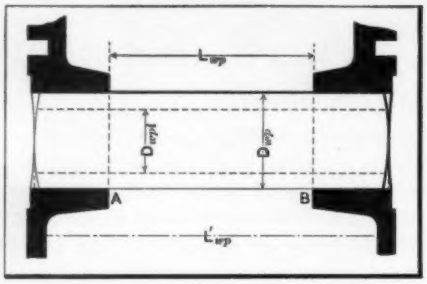


Fig. 3—Cross-sectional view of a piston, showing the wrist pin and the different dimensions used in calculating the dimensions of same

1. *Calculation of rigidity.*

Let:

D_{wp} = exterior diameter of the wrist pin in inches.

D_{wpi} = interior diameter of the wrist pin in inches.

L_{wp} = longitudinal bearing surface of the wrist pin in inches.

D = bore in inches.

P_m = maximum pressure of the explosion in pounds per square inch on the face of the piston.

S_b = unbalanced effort admissible in the extreme fibers in pounds per square inch.

K_{wp} = admissible unbalanced pressure normally at the lateral surface on the extremities of the wrist pin in pounds per square of projected surface.

I = moment of inertia of the section of the pin.

e = distance of the extreme fiber = one-half diameter of pin.

By referring to Fig. 3 the pin is similar to a girder supported in A and B and weighted in the center by the total maximum pressure of the explosion.

The resultant moment of flexion M_b is, therefore:

$$\text{(b)} \qquad M_b = \frac{P_m \dfrac{\pi D^2}{4} L_{wp}}{4} = \frac{S_b I}{e}$$

from which

$$D_{wp} = \sqrt[3]{\frac{2 P_m D^2 L_{wp}}{S_b}}$$

But:

$$\text{(c)} \qquad S^b = \frac{2 P_m D^2 L_{wp}}{D^3_{wp}}$$

for solid cross-heads.

The same manner:

$$\text{(cc)} \qquad S_b = \frac{2 P_m L^2 D_{wp} D_{wp}}{D^4_{wp} - D^4_{wpi}}$$

for hollow wrist pins.

2. *Calculations of the unbalanced pressure on the exterior surface.*

The pin supports the maximum pressure previously called P_w total. This takes place at the commencement of the piston stroke; that is to say, near the dead center.

We therefore have:

$$K_{wp} \times D_{wp} \times L_{wp} = \frac{P_m \pi D^2}{4}$$

from which

$$\text{(d)} \qquad D_{wp} = \frac{P_m \pi D^2}{4 K_{wp} L_{wp}}$$

and

$$\text{(e)} \qquad K_{wp} = \frac{P_m \pi D^2}{4 D_{wp} L_{wp}}$$

In practice these cross-head pins are calculated from the following formulæ:

$D_{wp} = 0.34\,D - 0''.53;$

$D_{wpi} = 0.572\,D''_{wp};$

$L_{wp} = 2.25\,D''_{wp}.$

Maximum unbalanced pressure of the explosion.	Maximum longitudinal strain S_b per square inch.	Maximum pressure on the exterior surface K_{wp} per square inch.
250 pounds	23,000 to 29,000 pounds	1,600 to 2,000 pounds
300 "	26,000 to 35,000 "	1,900 to 2,400 "
350 "	32,000 to 40,000 "	2,200 to 2,800 "

The following diverse formulæ are in use:

$L'_{wp} = 0.95\,D'' \begin{cases} L'_{wp} = \text{total length in inches of pin.} \\ D = \text{bore in inches.} \end{cases}$

Space between the wrist pin and the face of the piston $= 0.5\,L_p$ (L_p = length of the piston).

For the bosses that carry the wrist pin:

$$D_{wpb} = 1.2\,D_{wp} + 0''.25.$$

D_{wpb} = Exterior diameter of the boss in inches.

D_{wp} = Exterior diameter of the pin in inches.

Weight of the cross-head pin W_{wp} (in pounds).

$W_{wp} = 0.276\,D - 0.65$ pounds (D = bore in inches).

Short Stories of Common Interest

Unraveling the Puzzling Situations

Relating the things of interest in explanation of the situations that serve as the foundation for argument, the idea being to explain away the fallacies and lay bare the facts. With 100,000 new automobilists coming into the field every year, the thousand and one things that are as A. B. C. to the experienced man have to be coped with by the fellow who has the world and its joys before him.

EFFECT of heat on the size of the piston, according to the usual estimate, is a condition that is to be remedied by the mere expedient of making the diameter of the piston some thousandths of an inch less than the bore of the cylinder. In a relatively inferior motor, the clearance, so-called, is of such magnitude that the piston, however much it expands when it is heated up, will not stick. In the meantime, a test of a motor so made is likely to show that the leakage of mixture by the piston rings into the crankcase is greatly in excess of that which is dictated by prudence. Making a motor that will run, however indifferent the performance, is all that can happen if it is the idea of the designer to add to the clearance the amount that will save him the trouble of doing a measure of real designing. The better class of motors work with a clearance of not more than 0.006 of an inch at the piston head, tapering the piston to 0.004 of an inch at the other extremity. In working to these narrow limits, if the piston is light, in order that the secondary moment will be negligible, it is necessary to take into account the deformation of the piston, due to the angularity of the connecting rod at the instant of maximum pressure, and a very good way to take care of this difficulty is to grind the piston on its diameter so that it will be slightly elliptical, the major axis of the ellipse coming in the plane of the connecting rod, and the minor axis of the same coming in the plane of the piston pin. The difference between the major and the minor axes may be in the neighborhood of 0.004 of an inch. Authentic advice in-

dicates that the pistons of the silent Knight motor have an allowance for deformation. In another case of a six-cylinder motor the allowance in grinding the piston was given as follows:

At the first bridge 0.008.

At the second bridge 0.007.

At the third bridge 0.006.

At the fourth bridge 0.005.

The bridges as referred to in this case represent the spaces between piston rings. In this particular piston, the portion between the fourth bridge and the wrist pin was given a clearance cut of 0.005 of an inch, and the portion between the bottom of the piston and the wrist pin was given an allowance of 0.003 of an inch. The result obtained in this case was fairly good.

* * *

HOT WATER is a good fluid to employ in the heating of the gasoline as it passes from the nozzle of the carbureter to the air en route to the combustion chamber of the motor for the reason that the temperature of the water is maintained at 212 degrees Fahrenheit when it is steaming, and no matter how much heat is applied to the water as long as there is any of the liquid present the temperature will remain constant. Not so with heated air. The addition of heat to the air has the effect of increasing the sensible temperature, due to the fact that there is nothing more absorbent from the point of view of heat than the specific heat of the air body. In the water, however, the change from liquid to gas (steam) takes place at a constant temperature, and it is the latent heat of evaporation that has to be satisfied in the dissipation or transfer of the energy in the form of heat. In view of the fact that heating the mixture reduces the weight per volume, it will be seen that the power of the motor will be reduced if the mixture is heated beyond the barest necessity as it is represented in the vaporization of the gasoline in order to form a mixture. Being able to supply the heat of vaporization to the liquid gasoline, at a constant temperature, and having the means at hand for maintaining this temperature at the constant desired level, presents an excellent state of affairs, particularly when account is taken of the fact that this facility is normal to the process, hence dispensing with any mechanism as a requisite to the air. In order to show the performance of a water-jacketed carbureter a report by J. M. L. Howe is given as follows:

Laboratory Test of the Williams Carbureter Under a Variety of Conditions

In this test, according to Mr. Howe, the initial adjustments were made by the maker of the carbureter, and water was fed to the jacket of the same through a 5-16-inch outside diameter copper pipe, connecting with the discharge from the water-jacket of the cylinder, and it was observed that the temperature of the water was approximately 55 degrees Fahrenheit. The motor used was a four-cylinder automobile type with a 23 per cent. compression, running in the laboratory without a muffler. The first three runs were made with a standard manifold of 1 1-8-inch diameter tubing, measuring the bore of the same, and the last two runs were made with a 1 1-4-inch inside diameter manifold. Prior to each run the engine was inspected and the valve timing was checked. The results arrived at are given in tabular form as follows:

RUN A.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	53.50	26.50	15.9
700	53.125	26.125	18.3
800	53.125	26.125	20.9
900	53.125	26.125	23.5
1000	52.50	25.50	25.5
1100	52.120	25.125	27.6
1200	50.150	24.50	29.4
1300	50.	23.00	29.9
1400	49.	22.00	30.8
1500	48.	21.00	31.6
1600	46.	19.00	30.4
1700	45.75	18.75	31.9
1800	45.125	18.125	32.7
1900	44.50	17.50	33.2
2000	44.125	17.125	34.3

RUN B.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	52.50	25.5	15.3
700	52.50	25.5	17.8
800	52.75	25.75	20.6
900	52.75	25.75	23.2
1000	52.50	25.50	25.5
1100	51.75	24.75	27.2
1200	51.50	24.50	29.4
1300	50.50	23.50	30.6
1400	50.00	23.00	32.2
1500	48.125	21.125	31.6
1600	47.75	20.75	33.2
1700	46.120	19.125	32.5
1800	45.50	18.50	33.4
1900	45.	18.00	34.2
2000	44.125	17.125	34.3

RUN C.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	53.	26.	15.6
700	53.125	26.125	18.2
800	53.	26.	22.8
900	52.50	25.5	23.
1000	52.125	25.125	25.125
1100	51.50	24.5	27.
1200	51.	24.	28.8
1300	49.	22.	28.6
1400	48.78	21.75	30.4
1500	48.	21.	31.5
1600	46.50	19.50	31.2
1700	45.75	18.75	32.
1800	44.75	17.75	32.
1900	44.	17.	32.8
2000	43.50	16.50	33.

RUN D.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	51.	24.	14.4
700	52.75	25.75	18.
800	53.	26.	20.8
900	52.75	25.75	23.17
1000	52.75	25.75	25.75
1100	52.75	25.125	27.63
1200	51.50	24.50	29.4
1300	51.	24.	31.2
1400	50.75	23.75	33.25
1500	50.00	23.	34.5
1600	49.125	21.125	34.
1700	47.	20.	34.
1800	46.75	19.75	35.55
1900	46.00	19.	36.1
2000	44.75	17.75	35.5

RUN E.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	52.75	25.75	16.5
700	53.	26.	18.2
800	52.75	25.75	20.6
900	52.50	25.50	23.
1000	52.	25.	25.
1100	52.	25.	27.5
1200	51.25	24.25	29.6
1300	50.50	23.50	30.7
1400	50.	23.	32.2
1500	48.75	21.75	31.5
1600	48.	21.	33.6
1700	47.125	20.25	34.4
1800	47.	20.	36.
1900	45.125	18.125	34.5
2000	43.75	16.75	33.50

RUN F.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	54.50	27.50	16.5
700	54.75	27.75	19.4
800	55.0	28.00	22.4
900	55.75	28.75	25.8
1000	55.50	28.50	28.5
1100	55.00	28.00	30.8
1200	54.75	27.75	33.3
1300	54.125	27.125	36.0
1400	53.125	26.125	36.4
1500	52.75	25.75	38.6
1600	51.50	24.50	39.2
1700	50.00	23.00	39.1
1800	48.50	21.50	38.8
1900	48.00	21.00	40.0
2000	46.75	19.75	39.6

RUN G.

Speed.	Brake Load—Gross.	Brake Load—Net.	B. H. P.
600	51.5	24.5	14.7
700	52.0	25.0	17.5
800	54.0	27.0	21.6
900	55.50	28.50	25.6
1000	55.75	28.75	28.75
1100	55.25	28.25	31.1
1200	54.0	27.	32.4
1300	53.0	26.00	33.8
1400	52.50	25.50	35.7
1500	52.00	25.	37.5
1600	51.25	24.25	38.8
1700	50.75	23.75	40.4
1800	49.50	22.50	40.5
1900	49.00	22.	41.8
2000	48.0	21.	42.

THE man who runs his car too fast over bad roads is designed to be the sub-tenant of a poor-house keeper.

Maximum Pressure in Torsion Tubes

A Company Investigation That Tells a Story

In the regular course of events in the laboratory of one of the American makers of automobiles it was desired to know the conditions of torsion tubes and a report of the investigation, as it was made at the time, appears as follows—this report is in some detail.

THE weight on the rear wheels is given as 1,505 pounds. The maximum stress will occur when the wheels are against some obstruction and are lifting the back end of the car. The wheels would probably not mount the obstacle if the angle between the point of contact, the wheel hub and the ground was greater than 60°.

Assuming 60° as the maximum value, there is a force of 1,505 pounds, acting at an angle of 60° with the spoke of the wheel at the point of contact. This force resolves into two, one along the spoke and the other perpendicular to it. The perpendicular force is the torque exerted at this point.

$$\text{Torque} = 1{,}505 \cos. 30°.$$
$$= 1{,}505 \times 0.866 = 1{,}305 \text{ lbs.}$$

In a case like this, the speed would, of necessity, be low, and assuming a constant speed of rotation for the wheel, the moments about the center of the axle equal zero.

The wheels are 36" in diameter, and the gear which drives them is 8 3-4" in diameter.

$$18 \times 1{,}305 = 4.38 \times T.$$

T = 5,360 lbs. tooth pressure on gear at center of rear axle.

The rear end of the main shaft carries a spur gear which meshes with the above and must, of necessity, transmit the same tooth pressure. The torsion tube and gear case are, in reality, a long lever supported on bearings at the rear axle and prevented from turning by the forward torsion tube bracket. The force tending to turn this lever is the reaction of the shaft bevel gear previously mentioned, and is equal to the torque on the axle driving gear.

Taking moments about the axle as equal to zero:

$$\frac{5{,}360 \times 4.5}{70.5} = 319 \text{ lbs.}$$

In case of backing, the force is downward and is resisted by four 3-8" bolts. This gives a load of 80 lbs. per bolt.

In case of a suddenly applied load, the stress is double that experienced when it is applied gradually. The latter being true in this case, the load becomes 160 lbs. per bolt.

The torsion tube bracket has two bolts subjected to shear and two subjected to tension. The load on the bolts in shear equals 160 lbs.

Allowing 40 lbs. for initial tension, the bolts in tension will have a load of 200 lbs.

These bolts are 3-8" in diameter—24 threads per inch. Area at base of thread equals 0.0903 square inch. Stress per square

$$\text{inch in tension} = \frac{200}{.0903} = 2{,}230 \text{ lbs.}$$

A. L. A. M. Bulletin No. 33A, page 241, gives for "Screw Steel" 85,000 lbs. per square inch as the tensile strength.

$$\text{This would give a factor of safety} = \frac{85{,}000}{2{,}230} = 38.1.$$

The same bulletin, page 240, gives for nickel steel tensile strength as the same, giving the same factor of safety in case it is used.

A 5-16" 24-thread bolt has an area of 0.0600 square inch. Factor of safety in case this bolt was used

$$= \frac{85{,}000 \times .06}{200} = 25.5$$

The rear connection of the torsion tube is only 17 3-8" from the axle. The force here

$$= \frac{5{,}360 \times 4.5}{17.4} = 1{,}386 \text{ lbs.}$$

In this case all of the bolts are in shear. At this joint there are six 7-16" bolts. Allowing double for suddenly applied load gives 462 lbs. per bolt.

Areat of 7-16" 24-thread bolt = 0.126 square inch.

$$\text{Unit stress} = \frac{462}{.126} = 3{,}670 \text{ lbs. per square inch.}$$

When the tensile strength is 75,000 lbs. per square inch, the

$$\text{factor of safety is } \frac{75{,}000}{3{,}670} = 20.4$$

For a 3-8" 24-thread bolt the factor will be

$$\frac{75{,}000 \times .0903}{462} = 14.7$$

Material in the torsion tube rear connection to resist shearing.

Area 3 3-4" circle is	11.0 sq. in.	
" 3 1-4" " is	8.9 sq. in.	
Difference	2.1 sq. in.	
Six fins 3-16" x 5-8"	= 0.7 sq. in.	
Total area	= 2.8 sq. in.	

$$\text{Shearing stress per sq. in.} = \frac{2{,}772}{2.8} = 990 \text{ lbs.}$$

For malleable iron the tensile strength under shear is 15,000 lbs. per square inch; hence the factor of safety is 15.

Determination of Tensile Strength in Bolts on Flange Connection

Moment of inertia of a circle about its axis = $1\text{-}4 \times r^4$.

Diameter of bolt at root of thread = 0.40; area = 0.126.

$$r^4 = (0.2)^4 = 0.00016$$

$$Ig = \frac{3.142 \times .00016}{4} = 0.00126$$

The moment of inertia of a figure about an axis parallel to the gravity axis = $Ig + Fd^2$.

Ig = moment of inertia about the gravity axis.

F = area of the figure.

d = distance between the two axes.

The flange is put on in such a manner that the neutral axis passes through two of the bolts and the other four are each 2.06" from the axis.

Moment of the four bolts off the axis =

$$4\ (0.000126 + 0.126 \times 2.06^2)$$
$$= 2.\ 1395.$$

Total moment of inertia

$$= 2 \times .000126 + 2.1395$$
$$= 2.\ 1397 \text{ or } 2.14$$

Considering the point of the tube forward of this flange as a free body, there is a force of 319 lbs., which has a lever of 53.1".

$$\text{Moment} = 53.1 \times 319$$
$$= 16940 \text{ inch lbs.}$$

For any beam

$$M = \frac{pI}{e}$$

M = moment of flexure
= 16490

p = maximum stress per square inch

I = moment of inertia of the section
= 2.14

e = distance of outermost fiber from the neutral axis

$$p = 16940 \times \frac{2.06}{2.16} = 16{,}500$$

Ultimate strength of bolts
= 85,000 lbs. per square inch

$$\text{Factor of safety} = \frac{85{,}000}{16{,}500} = 5.1$$

Torsion tube has to resist the same forces.

Tube is 3 1-4" diameter with walls 0.125" thick.

Moment of inertia of a ring about a gravity axis

$$= 1\text{-}4\,\Delta\,(r1^4 - r2^4)$$

$$Ig = \frac{\Delta}{4}\left[(1.625)^4 - (1.5)^4\right]$$
$$= 0.7854\ (6.975 - 5.062)$$
$$= 1.501$$

$$e = r1 = 1.625$$

$$p = 16940 \times \frac{1.625}{1.501} = 18350$$

$$\text{Factor of safety} = \frac{85{,}000}{18{,}350}$$
$$= 4.64$$

R. A. C. Wants Rear Lights for All Vehicles

Royal Automobile Club of the United Kingdom is agitating for the enactment of a law compelling all vehicles, horse-drawn as well as motor-driven, to carry red lights at the rear after nightfall. Legal Committee indorses movable headlights.

THE General Committee of the Royal Automobile Club of London has received an expression of opinion from the Legal Committee concerning the use of headlights to move with the steering gear. The opinion is that "if headlights are fixed so as to move with the direction of the car, in such a manner that the rays would at all times be projected in a straight line in the direction in which the car was intended to proceed, there would be no breach of the regulations of the Local Government Board." In view of the urgent need in London for the rear-lighting of all vehicles at night, the General Committee of the club has resolved to begin an active campaign to urge and encourage the use of a red light not alone upon automobiles, but upon all horse-drawn vehicles, including pantechnicon vans, farm cars, wagons, etc., as well as motor-cycles and other pedal cycles. The committee will make a special effort to enlist the co-operation and influence of the local authorities in country districts, farmers' associations and cycling organizations in order to spread the crusade and make it general throughout Great Britain.

THE International Agricultural Exhibition which has just closed in Buenos Ayres was the occasion of some fine automobile exhibits, but chiefly of British-made motor cars.

It Stands to Reason—

THAT metal-to-metal discs for clutches will give trouble if slipping is indulged in—the edges of the plates will fray out.

THAT clutches are not intended to be lubricated—the oil will induce slipping.

THAT the liquid used in multiple disc clutches is not a lubricant; it is made of lubricating oil and kerosene.

THAT the liquid, when it wears out, must be removed from the clutch housing, otherwise it will gum up the discs.

THAT fabric facings for clutch discs will adhere to each other if they are not kept apart when the car is in storage.

THAT trouble is not overcome by hiding it in a housing; keep the inside of the housing free from foreign matter.

THAT a sweet-running automobile will be of the imagination unless the clutching mechanism is given its measure of care.

THAT the transmission gear and the differential system must be overhauled and cleaned out at sufficiently frequent intervals, otherwise the parts will gum and stick.

THAT too much oil in the live rear axle means that some of it will drip down over the spokes of the road wheels and land on the tires, to the detriment of their life.

THAT there is nothing under the sun that will kill tire life so effectually as oil.

THAT the appearance of an automobile is much marred when it is smeared over with worn-out lubricating oil and the grease that comes from the chauffeur's hands.

THAT the grease can be washed off the body by using caustic materials, but the delicate tint departs on the same train.

THAT the way to keep a body looking up to its original sparkle is to avoid smearing the surfaces with grease.

THAT washing is a sufficiently detrimental process if clean mud is all that has to be taken off.

THAT mud and grease make a cement that is death to the appearance of the car.

THAT tops show neglect—the appearance tells the story.

THAT the fabric of which a top is made is poor material to withstand the ravages of grease.

THAT the rubber compound, which is frictioned on the layers of the fabric of which the top is made, deteriorates under a grease spot.

THAT the grease spot is a snare for dust, and it makes an indelible mark.

THAT tops are damaged in other ways by neglect in that the bows are broken and the fabric is crumpled when the tops are not done up.

THAT a good automobile with a top in need of attention looks like a rag-tag.

THAT it takes but a moment to fold the top back, iron out the creases, strap it down and adjust the cover into place.

THAT the cover becomes a receptacle for a bushel of dust, unless the flap is buttoned over the front and the dust is excluded thereby.

THAT some tops are so made that the automobilist is not of earthly clay who can get any good out of them.

THAT a few dollars more would suffice to purchase a real top, and the appearance of the automobile would be perceptibly better.

THAT all tops look very much alike in a dark basement; take them out where they can be seen; do this before making the purchase.

THAT the bows should be strong and well ironed; this is not the case in some examples.

THAT the strap should not be made of imitation leather; such fabric goes with an imitation top.

THAT the color of the fabric does not always harmonize with the motif of the body.

THAT art has its place even in a top.

THAT it is a shame to highly finish a body and cap it with a wretched top.

Automatic Ignition Advance

Dealing with the Question of Increased Efficiency

C. Faroux, in the following article, which appeared recently in "La Vie Automobile," deals with the question of the increased efficiency to be obtained by the correct advance of the ignition, showing by diagrams the different firing positions and the maximum pressures resulting, introducing the new Bosch magneto with automatic advance, illustrations of which are given.

SHOULD the ignition be fitted with a variable advance? If the question is couched in these words it is a difficult matter to answer, but if the inquirer wishes to know "Does the motor efficiency increase if the ignition is advanced?" then the reply is decidedly in the affirmative. Koerting, who is a great technician on internal combustion motors, has recently established the fundamental relations between the inflammability of the carbureted mixture, the size of the combustion chamber and the number of revolutions of the motor.

Supposing v to be equal to the speed of inflammation (speed of the propagation of the wave of explosion), l the length of the flame (that is, the total length of the compression chamber) and n the number of revolutions per minute.

Examine for a moment the diagram shown in Fig. 1. The maximum pressure at the moment of explosion, which is equivalent to the completion of the inflammation, will be found to be the point a of the diagram.

During the time that the inflammation is taking place we have

$t = \frac{l}{v}$ (quotient of the length of the course and the speed of the inflammation)

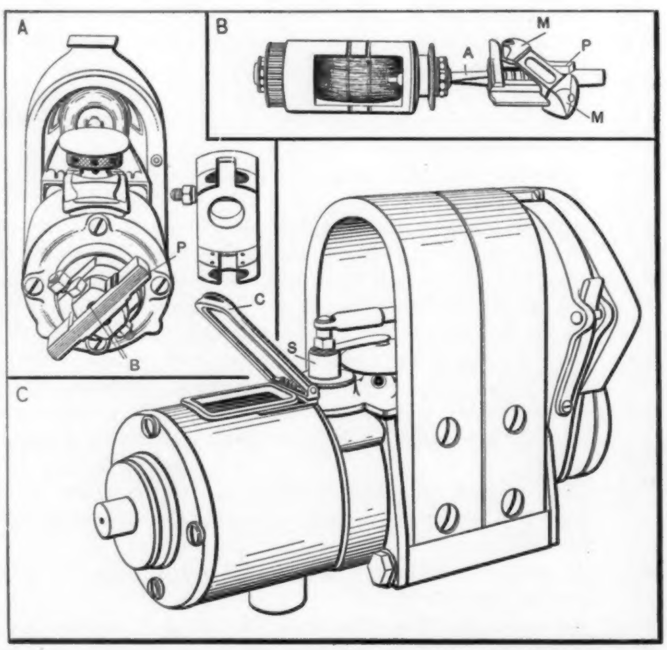


Fig. 3—Bosch magneto with automatic advance. A shows the magneto seen from the driven end, in which P is the spring driven through a series of plates. B shows the armature and the automatic advance mechanism in which A is the driving shaft carrying the helicoidal weight; M, the bronze weight; P, part on which the driving pinion is fixed and which is affected by the weight. C shows a complete Bosch magneto with automatic advance. The small cover permits the driver to properly lubricate the mechanism

an angle traveled by the crankshaft:

$$\beta = n\,t = 360 = n\frac{l}{v} \text{ degrees} \qquad (1)$$

and supposing the connecting rod to be infinite, the position corresponding to the piston

$$x = r\,(1 - \cos\beta)$$

r is the radius of the crank.

Now, supposing that all other conditions are equal, if one were to double the number of revolutions n the size of the angle β traveled by the crankshaft during the travel x of the piston until the inflammation is completed grows to

$$\alpha = 2 \text{ x } 360\, n\frac{l}{v} \text{ degrees}$$

$$y = 2\,(l - \cos\alpha)$$

and the pressure of the explosion does not reach beyond the point b. The angle of the inflammation, therefore, has doubled with the number of revolutions.

The surface $a\ b\ c$ expresses the loss of work caused by the inadmissible speed of the crankshaft. The formula (1) shows the method of overcoming this loss, and it consists of either increasing the speed of the inflammation v or diminishing the value of L.

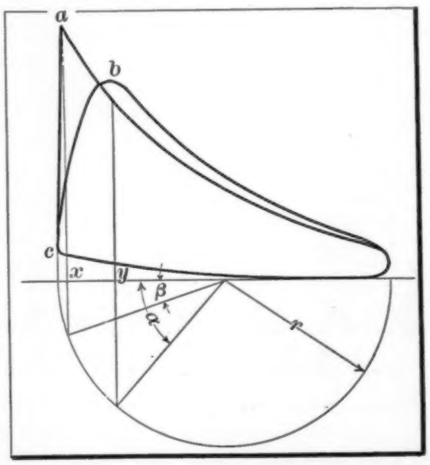


Fig. 1—Comparisons of diagrams obtained from a motor turning at n revolutions per minute (maximum pressure at a, the crankshaft having traversed the angle β from the top dead center), and a motor turning at 2 n revolutions (maximum pressure at a with the crankshaft having traversed the angle α larger than the angle β, the ignition taking place on the dead center

While on this subject it is well to note:

1. That the compression of the mixture is advantageous.
2. That it is as well to employ simple forms of combustion chambers with the spark plugs placed in the center of the body of mixture; that is to say, with hemispherical cylinder heads and high compression.

Hemispherical Types of Combustion Chambers Are Much in Favor for Three Reasons: From the Point of View of Efficiency, Facility of Water-Cooling and Ignition Facilities.

There is another means of decreasing the losses of work referred to above. This means is by causing the maximum pressure of the explosion to come nearer to the dead center, which can be effected by advancing the ignition.

If a given mixture, difficult to ignite, requires for its complete inflammation a period corresponding to the angle of lift of the crankshaft, as seen in Fig. 2, it is evident that the

pressure of the explosion is produced at the point *a* in the diagram. If the ignition commences, instead of on the dead center, before the end of the compression stroke, for example, at the position β of the crankshaft, the flame travel which results without change of speed is already terminated by the time the crankshaft has traveled through the angle α_0, and in consequence the maximum pressure position on the piston is brought back from the point *a* to the point *b*, which is nearer to the dead center.

Besides, advancing the ignition shows a gain in work corresponding to the difference between the surfaces *a b c* and *c d e* independent of the direct consequences of anticipated flame travel. The benefit to be derived will cease when the areas of the two surfaces become equal unless practical considerations, by which is meant knocking, do not previously intervene.

The Most Advantageous Moment for Ignition Depends as Much on the Nature of the Charge as the Size of the Combustion Chamber as Well as on the Speed of the Crankshaft.

It is this last consideration that particularly interests us, as the faster the motor turns the more advantage can be obtained from the advance of the ignition. It would be as well to express this numerically, which will better explain matters. Taking the conditions of a motor that exacts more than another that the spark be varied; that is to say, one with *l large* (*l* being, as before stated, the maximum length of the combustion chamber). In a motor with symmetrical valves and a 100-millimeter bore (3.9 inches), for example, if the spark plugs are placed, as is often the case, over the intake valves, the maximum length of the combustion chamber can be as long as 16 centimeters (6 5-16 inches). On the other hand, the speed of flame travel of the mixture, which is extremely variable, can, dependent upon the conditions, vary from 4 to 22 meters per second (13 to 75 feet per second). This last figure is not obtained except under certain conditions, and taking the number of meters to be 8 (about 25 feet) it will be nearer to that obtained under normal conditions.

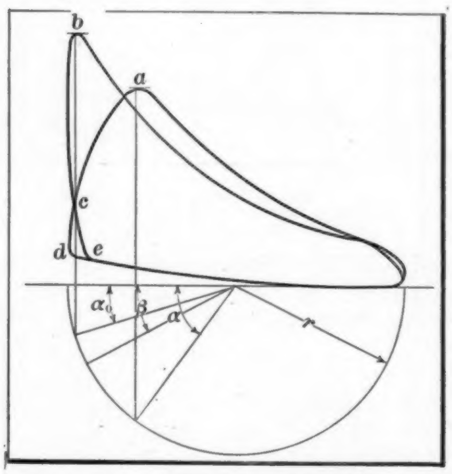


Fig. 2.—Comparison of diagrams with and without ignition advance. If the ignition starts at the dead center, the pressure curve rises following *d a* the maximum pressure is at *a* and the crank has already traversed the angle α after the dead center. If the ignition starts before the dead center when the crank still has the angle β to traverse before arriving at the dead center, the pressure curve rises along *e b* and the maximum pressure takes place in *b* after the crank has traversed the angle after the dead center. If β is augmented, that is to say, more advance is given, it is possible to diminish α_0 and obtain the maximum pressure at the dead center

If there $l = 16$ c|m

$v = 8$

according to the formula (*l*) given before, we find

$n = 500$ revolutions, an angle $\beta = 36$ degrees
$n = 1000$ " " " $\beta = 72$ "
$n = 1500$ " " " $\beta = 108$ "
$n = 2000$ " " " $\beta = 144$ "
$n = 2500$ " " " $\beta = 180$ "

It is quite certain that these values can be lessened in practice, but it is possible to see their order of importance as well as the fact that the variation of ignition advance becomes a necessity of first order when the motor works at very varying fluctuations, which is the case in automobile motors.

Care was taken at the outset of this article to point out that the conclusions to be drawn were in the case that an increase of efficiency was a desideratum. There are two schools of automobile designers, both good in their way.

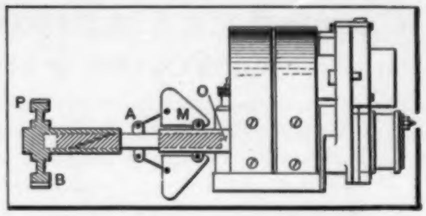


Fig 4—Design showing a method of obtaining automatic advance for the magneto

There is the school that draws out the quintessence and in doing so even goes so far as to slightly complicate the mechanism, and then there is the school whose main endeavor is to deliver to the clientèle a simple car that will need as little care as possible.

The Ignition Advance, when Placed Under the Control of the Driver, has Proved Oftentimes More of a Detriment than a Blessing—Some Drivers "Play" with the Levers.

These words are the keynote of the present theme. Ignition advance should not be placed in the hands of every driver, but is it not possible to have an automatic advance for the ignition system? Certainly, because the essential factor is the number of revolutions. There is nothing simpler than to fit to the shaft some centrifugal mechanism which by means of a sliding block and a spiral thread will allow an alteration to be made in the relation of the armature, and then there are numerous ways of doing this, and there are many that have been tried, as the question of automatic ignition advance is one that has received a great amount of attention at the hands of specialists in this class of work.

It is evident that such a means of command should be certain, strong and, above all things, not easy to get out of order. At the same time it should take up as little space as possible.

Referring to Fig. 4, the two bodies M fixed to the magneto drive-shaft rotate with the armature and are submitted to centrifugal force which tends to throw them out in the same way as an ordinary ball governor. A shaft A has a spiral thread, which is able to slide without turning in the shaft O attached to the driving gear, in the manner shown in the illustration.

When the bodies M expand from their normal position, which takes place as soon as the angular speed of the motor has passed a certain limit, the shaft A is drawn by the action of the weights toward the magneto. But the spiral thread forces it to turn in relation to the driving pinion P in turning it. As presented, this form would offer several inconveniences, the main being that as the weights are attached by small arms which would in time wear, and throw the timing out. In the Bosch magneto, shown in Fig. 3, there is only one weight, thereby suppressing difficulty of setting, absence of levers and the weight being attached direct to the shaft. Several constructors, and they are a large number, have remained antagonized to automatic advance, claiming that it is complicated and that by the mere fact of increased angular speed the spark is hotter. From tests that have been carried out recently it has been shown that the heat of the spark is a negligible quantity and that it in no way showed the same results as the automatically advanced type.

Point Concerning Gasoline Vaporization

Gasoline out of the nozzle is more likely to be in stream formation than as a spray, the stream being made up of a solid portion surrounded by torn-off globules, some of which are relatively large and the rest grading down to vapor size. The outer wall of vapor tends to hide the solid central stream and the larger chunks of gasoline which form between the solid stream and the vapor-like outer wall.

Canada's Capital Adopts Motor Fire Wagons

After a thorough investigation of the subject the City Fathers of Ottawa have decided to go in for motor fire apparatus. They have made a start by entering into a contract for a combination hose and chemical wagon, and will gradually increase the motor-driven equipment until the entire department has been so equipped. A saving of at least 40 per cent. in the running expenses of the department is expected to result.

OTTAWA, CANADA, is going in for automobiles for fire purposes. The start has been made by the placing of a contract the other day for a combination hose and chemical wagon, the purchase price of which was $7,850. The City Fathers have proclaimed themselves as being imbued with the modern spirit, and even the most sanguine of their number admits that within twenty years from to-day the entire fire department of Ottawa will be equipped with the most modern fire-fighting apparatus that money can buy.

The combination chemical wagon is to be an 80-horsepower machine. It is to have four wheels, the front wheels 36 inches high and 4 inches wide, the rear ones dual wheels 38 inches high, with an 8-inch traction, and a wheelbase of 130 inches. The chemical wagon will carry 1,000 feet of hose; two tanks, each with a capacity for holding 35 gallons of a chemical for extinguishing fires, besides extension ladders, and the usual supply of accessories. Ten firemen will be able to ride on the wagon and the intended speed of the vehicle is 50 miles an hour. By the introduction of automobile fire apparatus to replace the horse-drawn equipment now in use the Municipal Government of Ottawa expects to save at least 40 per cent. in the running expenses of the fire department.

Ottawa is, however, no exception among the Canadian cities to have gone in for automobiles for fire purposes. Hamilton has its order in for one machine, New Westminster has two in operation, Victoria possesses two, Prince Rupert has two, while there are no less than eleven being successfully operated in Vancouver.

Extended Scope of Electrical Equipment

Illustrating small electric motors that are designed for use in valve grinding and similar ventures, and discussing the considerable range of portable tools, not only in the plants where automobiles are made, but in the private garage, affording opportunities to the owner to reduce the cost of maintenance, first by preventive measures, and second by the presence of facilities such as will permit him to undertake the making of repairs without helping to support a public institution.

INTRODUCING electrical equipment into the plants of the makers of automobiles has been at a slow but steady rate, beginning with the use of electric motors to drive groups of machine tools, extending the scope of these drives to the point where individual motors were placed on the respective tools, and finally producing combinations of electric motors with tools, thus making it possible to move the tools to the work, rather than to bring the work to the tools.

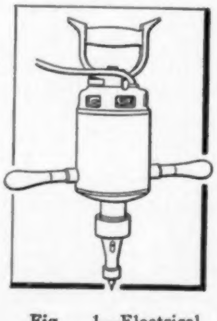


Fig. 1—Electrical drill that can be used as a valve-grinding tool with either oscillating or rotating movement

The principle of bringing the tools to the work was introduced some years ago in connection with the larger undertakings, and it was found to be of excellent advantage to proceed along these lines. But if advantage resides in this method of procedure in the plants where heavy equipment is produced, it is not too much to expect that the advantage will be multiplied if small motors equipped with suitable tools are given to each of the workmen, if only it may be said the condition designated as "portability" is fittingly represented, and the workman is permitted to accomplish the successive operations with speed and precision, without having to move the work. In this way it is possible to surround a given undertaking, using a number of men simultaneously, each performing necessary operations without interfering with adjacent operations.

In some of the plants where automobiles of a high character are being made the first operation is to gather the side bars and cross members of the chassis, collecting enough material for 50 or 100 automobiles, preferably the latter, in a lot, and the gangs of men who are assigned to assembling the chassis frames rivet the members together, using muffled types of rivet heaters and pneumatic riveters, so that, if a hundred chassis frames are to be assembled, a hundred gangs of men may start at a common time, and the work progresses step by step, each gang keeping up with the leading team, not unlike the plan that has been worked out in the erecting of buildings, utilizing bricklayers on the walls, the pace being set by the most skilled of the men occupying the end positions.

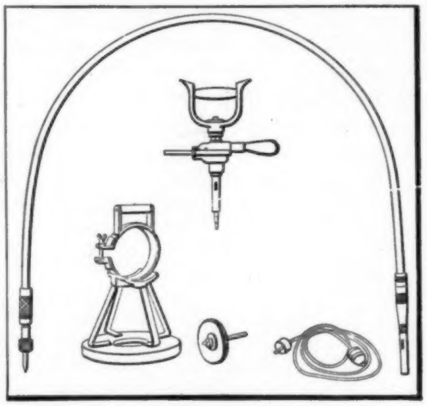


Fig. 2—Special equipment that can be used in connection with the Pioneer valve grinder and drill as shown in Fig 1

The chassis frames as riveted together stand in a row just where they are to remain until the automobiles are completed, ready to be taken to the testing department to be tuned up. The pneumatic riveting machines were found to be of such great advantage on account of their portability and other desirable characteristics that a positive want was created for other forms of portable tools for the purpose of continuing the gang system by means of which the simultaneous building of all of the automobiles of a given lot could be furthered.

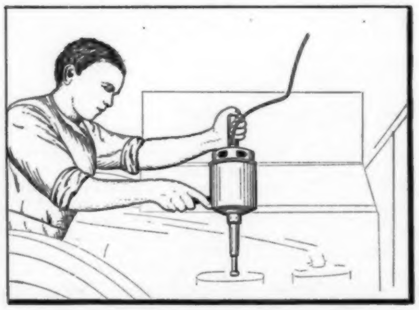


Fig. 3—Showing an operator using the portable electric machine for grinding in the valves

Small electric motors were investigated with a view to working out a plan of this character, and, as experience lent facility to the enterprise, the range of uses of these electric motors was broadened, and it was also found that the limit receded in proportion as special jigs and fixtures were contrived for the guiding of the tools in the accomplishing of the work. In the Cadillac plant at Detroit, for illustration, the electric motors are built as independent units, the transmission gears are completed on a unit basis, and in like fashion the live rear axle and the front axle units are made, and as these units are brought to the assembling room, following the erection of the chassis frames in gangs in the manner as above described, they are picked up by suitably contrived hoists, and, limiting discussion to the motor in a given case, for illustration, after it is picked up and placed over the chassis frame, a fixture is brought into play and portable electric drills are used to drill the holes in the chassis frame to accommodate the fastening of the motor, so that when it is dropped down onto the frame it is brought to rest and bolted

into place with such great precision that any motor of a given model made in the plant will fit any chassis frame for which it is designed, thus catering to the principle of interchangeability without departing from the principle of simultaneous and progressive gang operations in the erecting department.

Overhead Charges May Be Trimmed by Reducing the Initial Cost of the Shop Equipment Through the Use of Portable Tools, Utilizing Small Electric Motors as Driving Members and as the Frame by Means of Which the Tools are Supported.

When the last word has been said, it will be seen that the most effective machine tool that it is possible to employ is the one that comprises the power for driving purposes and the tool for cutting work. Anything that will eliminate long mechanical transmission systems and masses of metal in the shape of machine tools will cut down the initial investment and reduce the mechanical losses during the period of operation. These measures will influence the overhead charges, first by reducing the measure of the investment, second by reducing the total of the depreciation, third by favorably operating upon the upkeep cost, and finally by hastening the work, since a plurality of men are permitted to do operations simultaneously on each unit that is being finished. It may be seen at a glance that a small electric motor, if it will serve for the drilling of a hole by the simple expedient of putting a socket on the end of the driven shaft of the motor and placing a drill in the socket for use in drilling the hole, using a jig to guide the work, is a relatively inexpensive tool as compared with a drill press that must be big enough to accommodate the unit that is being built up, even though the hole that is to be drilled is so small that a little portable drill will be more sensitive and satisfactory than the big tool that has to be large because it must accommodate the unit based upon its proportions, which bear no relation to the size of the hole that has to be drilled. The new idea is infinitely more efficacious than the old plan, and certainly the portable tool, weighing perhaps a hundred pounds, including the source of power in the form of an electric motor, will be a minimum investment as compared with a 2,000-pound drill press, an array of shafting and belting, and finally an electric motor or other source of power, placed remote from the point of its use, as represented in the old idea.

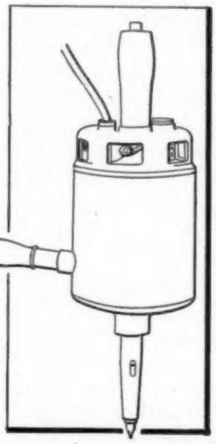


Fig. 4—Type B Pioneer valve-grinding tool with centrally located spindle

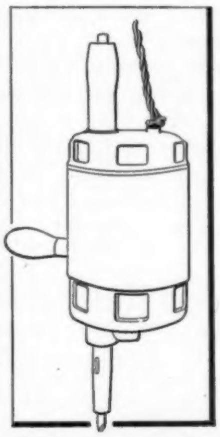


Fig. 5—Type A Pioneer valve grinding tool of the offset spindle type

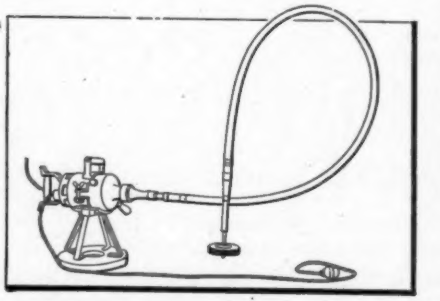


Fig. 6—Showing the Pioneer tool used as a polishing tool for small parts and inaccessible places. An extended switch is supplied

Take a Lesson from the Building of Battleships—They Cannot Be Lifted and Placed Upon the Platen of the Tool Because They Are Too Big and Cumbersome, so That They Are Built Up in Stocks, Utilizing Portable Tools.

The new idea, so called, is really very old, and in shipyards, from the earliest time of the building of vessels, the practice has been to bring the material to the place of assembling, and through the good office of portable tools continue the task to completion with never a thought of moving the work about to accommodate the fixed location of the machine tools. In these days, in the well-equipped plants, traveling cranes and like equipment permit of the handling of the most weighty parts, enabling one man to supply the needs of a whole department in this respect; but despite the progress that has been made, the room for improvement is mighty, and evidence of lack of appreciation of the broad principle of this operation is seen in many places.

An example of a portable tool with multifarious uses can be seen in the accompanying illustrations. It has the appearance of an ordinary electrical drill, but, besides being suitable for every purpose that an electrical drill can be put to, it can be used at the same time as a valve-grinding tool. Figs. 4 and 5 show the tool as fitted out for this purpose alone. The tool is placed over the valve as shown in Fig. 3 and by pressing a knob switch under the control of the operator's left hand the spindle has a continuous back-and-forth movement and a complete turn is obtained by means of the handle at the side. The weight of the tool is such that it gives the right pressure on the valve against the seat and exerts an even pressure, which it is impossible to obtain by hand methods.

The type B C shown in Fig. 1 is a combination machine capable of either a back-and-forth movement as in the type A and B or of a rotating movement as given in any portable drilling or polishing machine. The top handle is made so that it can be either held in the hand or braced against the chest, and the two side-handles enable the operator to hold the machine steady when it is used as a drill. The control is by a switch conveniently situated. The chuck is made to accommodate various tools, and included in the outfit are the tools as seen in the illustration together with cord and plug to fit any lamp socket, a tool to fit valves and a drift for removing tools. A special equipment can also be furnished as shown in Fig. 2. The stand with a large base holds the drill and with the aid of a flexible-shaft buffing wheel and extension switch polishing and drilling in inaccessible places can be done. A device for right angle drilling will be noticed. This tool is suitable for private garages as well as workshops, as it fills the place of a buffing machine, emery wheel drill and valve grinder.

Taxameters on Horse Cabs

By equipping their vehicles with these devices, the owners of horse-drawn cabs in the German and French capitals have reduced the fares for travelers, with the result that they are regaining some of their lost patronage.

BERLIN and Paris alike have solved the problem of the horse-drawn cab and the taxicab through a very simple process. In both cases the drivers of vehicles are compelled to carry taxameters. The result is that the horse-drawn cab costs the "fare" from a quarter to a third less than the motor car. As a consequence, both forms of vehicles are seen in use. Many persons who have not formed the rush-habit so common to the modern world's inhabitants choose a hansom or a drosky, particularly if the day is fine.

If you mistake a "used" automobile for the nucleus of a honeymoon, you, as the groom, will surely pray for a divorce from a peck of trouble.

What Some Subscribers Want to Know

The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their automobile troubles, stating them briefly, on one side of the paper only, giving as clear a diagnosis as possible in each case, and a sketch, even though it may be rough, for the purpose of aiding the Editor to understand the nature of the difficulty. Each letter will be answered in these columns in the order of its receipt. The name and address of the subscriber must be given, as evidence of good faith.

Kick Coil Has a Single Winding

Editor THE AUTOMOBILE:

[2,662]—I desire to make a kick coil, so-called, and would be glad to have you tell me how to do the work. What size and how much wire will I use?

Philadelphia, Penna. BEGINNER.

Figure 1 shows a section of the coil. The core, of soft iron wire, in a bundle, using No. 10 B. & S. gauge, is bound around by insulating tape. Place a red fiber washer at each end as shown. Get three-quarters of a pound of double-cotton, insulated, No. 38 B. & S. gauge copper magnet wire, and wind the same in place, making a good job of it so that the wire will not take up too much room. Then wind tape over the wire, taking care to bring the two ends of the winding out, soldering on a No. 18 B. & S. gauge copper terminal wire, using a rubber insulated grade of the same for this part.

How to Remove Core-Sand From the Water Jackets

Editor THE AUTOMOBILE:

[2,663]—We are making cylinders for the first time in a small foundry that has been devoted to general work, and the question with us is to be able to remove the ore-sand from the water jackets. What would you advise? FOUNDRYMAN.

New York.

The best way to remove the core-sand from the cylinders is to use a sand-blast equipment in the manner as shown in Figure 2. The tank for the sand can be located at any convenient point, and the hose may be of considerable length, reaching to the work. It is desirable to place the work in a tight room on account of the dust that is raised during the bombardment of the work by the sand during the process.

Leather Facing of Cone Clutch Charred

Editor THE AUTOMOBILE:

[2,664]—I am having trouble with the clutch of my automobile. The last trip that I made before putting the car away in the Fall was over heavy roads with quite a number of difficult grades, and my clutch received an extra measure of hard work which it showed by a slipping tendency toward the end of the run. I thought very little of it at the time and put the car in dead storage for the Winter without giving it an overhauling. Everything seems to work all right now excepting that the clutch slips, and this you will understand it an intolerable difficulty that I must overcome. I am loath to send the automobile to a repair shop for fear a crop of imaginary troubles will be found, and the cost of operation, which has been reasonable up to the present time, will be boosted in consequence.

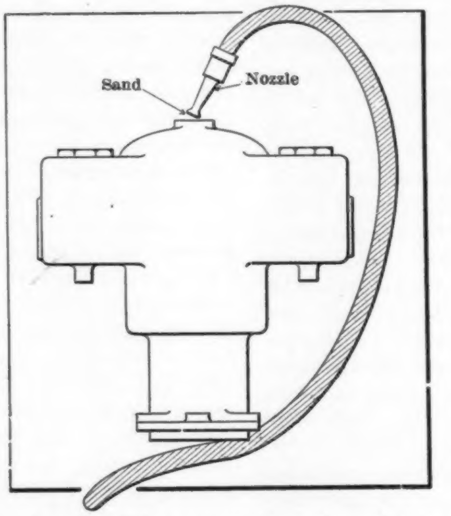


Fig. 2—Method of removing core-sand from the water jackets by means of a sand-blast equipment

Would it be possible for me to repair this clutch? I am a fair mechanic.

Boston, Mass. MECHANIC.

There is no reason why you should not reface the clutch, using chrome leather of about the same thickness as that which was employed originally, which leather you can get from a dealer in products of this character. Dissemble the clutch, which is a matter of a couple of hours' work for yourself and a helper; remove the old leather, and in putting the new leather on, fasten it at one end, utilizing the old fastening holes and copper rivets, and then by means of a clamp stretch the leather over the clutch, hammering it down with a mallet as you go along, and rivet one bent at a time until you work around the periphery, completing the undertaking. Be sure and replace the springs that the maker put under the original facing so that the leather will be pressed out, thus making intimate contact during operation. When the new facing is in place, you might apply a good grade of harness dressing with a brush, and give the clutch light service for a day or two, but if you find that the harness dressing is in excess, causing the clutch to slip, you can get rid of this excess by dusting talcum over the surfaces, using very little of it, of course.

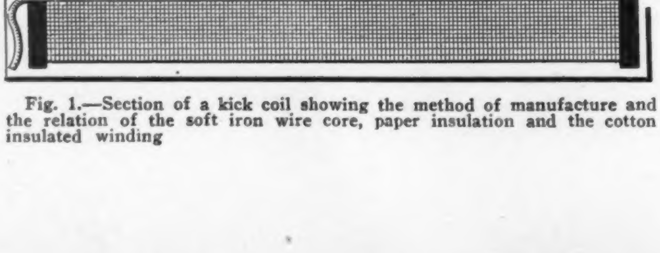


Fig. 1.—Section of a kick coil showing the method of manufacture and the relation of the soft iron wire core, paper insulation and the cotton insulated winding

Knuckle Pin Bushings Are Too Thick

Editor THE AUTOMOBILE:

[2,665]—My automobile, which is an 1908 model, is still doing good work, excepting that the front wheels wobble, and after tightening up the steering linkage joints all around, and taking the lost motion out of the steering gear, I still have the trouble of which I complain, and I begin to think that it will be impossible for me to cure this evil. The pin that holds the knuckle seems to be in good shape, but instead of using ball bearings in the knuckle, bronze bushings were employed, and they were originally about one-quarter of an inch of thickness of wall, and I observe that the walls have crushed out, making the bearing hole pronounced elliptical. I suppose I can replace these bushings, but in view of the fact that the metal originally used failed to stay, assuming that it was a good grade of bronze, I am at a loss to know how I can make a good repair. What kind of bronze will you use in making this repair, if, in your judgment, it is worth while?

New York City. AUTOMOBILIST.

The right material to use is phosphor-bronze cast from new metal, but the trouble in your case is due to the thickness of the walls of the bushings. You cannot hope to have the bushings wear well with such thick walls. If you will take a piece of drawn steel tubing about one-eighth of

What Other Subscribers Have to Say

The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their personal experiences for publication in these columns for the worthy purpose of aiding brother automobilists who may be in need of just the information that this process will afford. Communications should be brief, on one side of the paper only, and clearly put, including a rough sketch when it is possible to do so, and the name and address of the writer should be given as evidence of good faith.

an inch thickness of walls and use it as a backer for a phosphor-bronze bushing, the relatively thin bushing supported by the steel tube will serve for the purpose without "running" and a repair so made, which is not difficult, will undoubtedly give you good satisfaction.

Use an Oil-Stone to Re-Face the Contact Points

Editor THE AUTOMOBILE:

[2,666]—My coil worked nicely for over a year, but now I experience trouble with the contacts—they are pitted. What is the best way to fix them?

Cleveland, O. READER.

Figure 3 shows an oil stone of the ordinary variety, such as can be had at any hardware store at small cost. Drill a hole in the cover and tap it to fit the threads of the contact-screw, then face off the cover so that it will slide over the face of the stone. When the contact crew is in position, the little grinder so contrived may be used to face off the contact by the simple expedient of sweeping the cover over the stone and screwing down on the contact screw to generate the right degree of pressure. The time required to do the task is but slight, and the quality of the workmanship will be all that the occasion requires.

Muffler Is Fouled—Clean it Out

Editor THE AUTOMOBILE:

[2,667]—The oiling system of my motor worked badly all last season and I now fear that the muffler is burned out. The power of the motor is considerably reduced. Must I get a new muffler?

SOME EXPERIENCE.

Philadelphia, Penna.

The muffler is fouled. The oil that you allowed to accumulate in the system all last season is still there. The only difference is that it is in the shape of a semi-hard substance. Nothing remains but to take the muffler apart and scrape all of the surfaces, cleaning it thoroughly. Referring to Figure 4, of a muffler, it will be seen that the muffler may be taken apart by unscrewing the fastenings at the end, and after dissembling it will be seen that the pipes on the inside are perforated with many small holes, and it is more than likely that nearly all of these holes are stopped up; they must be cleaned out and in addition to scraping the surfaces to get rid of the hardened foreign matter, it will be worth while to soak the parts in kerosene oil, after which a solution of caustic

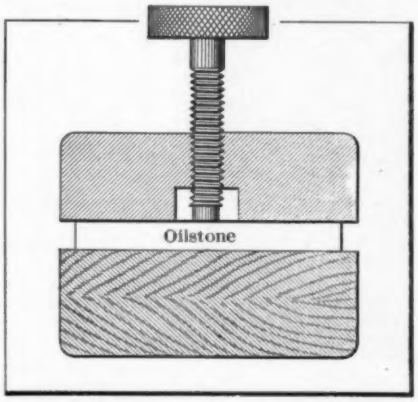


Fig. 3—Method employed in order to true up the points of the contact screws of the coil by using an oil-stone

soda may be used with the expectation that the inaccessible surfaces within the tubes will be cleaned also.

Information Needed on Various Subjects

Editor THE AUTOMOBILE:

[2,668]—Being a subscriber of THE AUTOMOBILE, I would like you to answer the following questions:

1. When opening the throttle does it increase the amount of gasoline that flows into the carbureter, or the amount of gas which goes into the cylinder?

2. What is the bore and stroke of the Blitzen Benz?

3. Why is it that it is said that you can get more power from a double chain drive than you can get from a shaft drive? It seems to me as if it would be the same, for you have a short shaft and a differential in the double chain drive and you have a shaft and a differential in the shaft drive.

4. Why is it that motors are timed to explode before the piston gets over center?

5. What is a full floating and semi-floating axle and what is the difference between them?

Liberty, Ind. L. E. HOWE.

1. Opening the throttle increases the orifice through which the mixture of gasoline vapor and air passes, consequently permits more gas to pass into the cylinders. It has no effect upon the amount of gasoline. This is regulated by the needle valve in the flaot chamber.

2. The bore and stroke is 155 millemeters by 200 millemeters, which converted into inches equals approximately 6¼ inches by 7⅞ inches.

3. You cannot get any more power out of the motor than there is in it and it is the motor that delivers the power in both examples.

4. An answer to this will be found in an article appearing in this week's issue of THE AUTOMOBILE entitled "Automatic Ignition Advance."

5. The difference between a full floating type and any other is that in the full floating type it is possible to withdraw the jackshaft after removing the hub cap. It should not be subject to any bending action but simply the torsion strain of the drive. In this type the axle casing is extended inside the hub and the ball bearings are mounted thereon.

Mathematical Considerations Involved in Steering Angles

Editor THE AUTOMOBILE:

[2,669]—Will you please inform me through your columns the mathematics involved in calculating the steering angle.

New York City. GEORGE B. MISH.

A reply to this question will be found in an article appearing in the last issue of THE AUTOMOBILE under the head of "Conserving Tires."

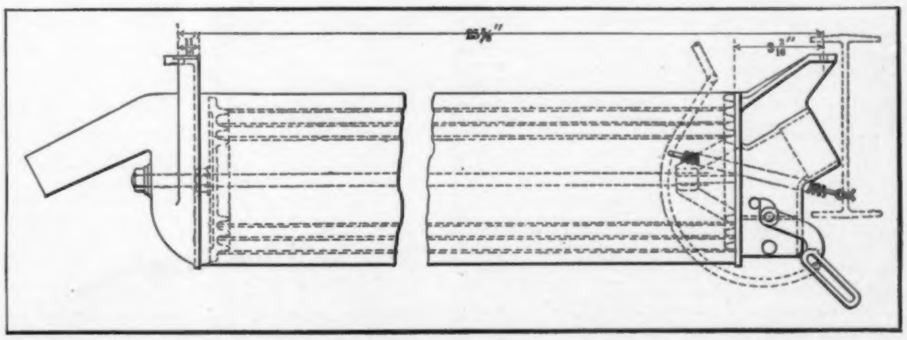


Fig. 4—Sectional view of a silencer showing how the ends are attached to the main body by means of an internal rod and exterior nut

Meeting Recurring Troubles

Presenting a Series of the Most Probable Cases

A series of co-related short stories, accompanied by diagrams and characteristic illustrations, indicating the nature of the troubles that are most likely to happen to automobiles, discussing their causes and effects, all for the purpose of arriving at a remedy. It is the aim, for the most part, to show how these troubles may be permanently remedied, and as a secondary enterprise it is indicated how the automobilist can make a temporary repair, thereby enabling him to defer the making of a permanent repair until a convenient time arrives.

When the Brakes Fail on the Hill Use the Motor—Experienced automobilists in mountain work are alive to the fact that the facings on the brakes would soon wear out were they used continuously without calling upon the motor to serve as a "drag." Remembering that a motor has one power stroke to three strokes that produce "pumping" losses, it will be seen that these pumping losses may be taken advantage of when an automobile is going down a steep grade, to do which requires that the spark be cut off and the automobile thrown into low gear. Unless the hill is very steep the drag of the motor will be sufficient to snub the downward motion of the car, and the brakes may be saved from the wear and tear that would otherwise result. The only disconcerting thing about this plan lies in the fact that a "muffler shot" will follow when the spark is thrown on again, due to an accumulation of explosive mixture in the muffler. Referring to Fig. 43, of a section of a valve which may be placed in the intake manifold between the carbureter and the cylinders, it will be seen that by turning the valve to one position the mixture from the carbureter may pass through the shell of the valve and on to the cylinders of the motor in the regular way, but if the valve is turned to its second position atmospheric air will be admitted to the motor, and the passageway from the carbureter will be shut off. A valve of this description placed in the intake manifold controlled by a mechanism from the dash would permit of cooling the motor on every down hill by the cold air that would be admitted in the manner as stated, and the snubbing action of the motor would supplant the brakes in their effort, thus conserving the automobile. The exact amount of the snubbing action might be varied at will by sliding the gears to any one of the positions available, it being the case that the motor will drag the most when the sliding mechanism is in low gear, and the amount of the drag will decrease as the gears are manipulated through the respective changes, being least on "high." This plan has the further virtue of keeping mixture out of the motor and the system beyond, unless it is ignited in the regular way; moreover, the economy of operation from the fuel point of view will be improved; nor is it too much to point out that carbon accumulations in the combustion chambers of the motor will be alleviated, due to the fact that fresh air, as it sweeps over the heated surfaces of the combustion chamber, will gather up some of the free carbon and sweep it out through the ports and away.

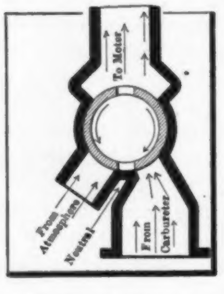


Fig. 43—Section of a valve in the intake manifold for use when the motor is a drag on the down grade

Carbon Accumulations Are Due to an Excess of Gasoline—In the past there has been so much talk about the cracking of the lubricating oil and the formation of a deposit of carbon out of the same, that automobilists generally labor under the false impression that the excesses of carbon, of which they so justly complain, are due to the use of poor lubricating oil, or the flooding of the cylinders with the same. It is highly improbable that a pure hydro-carbon lubricating oil will deposit carbon in the combustion chamber space in sufficient quantity to give any trouble at all. If the lubricating oil is adulterated with resinous oil there may be some cause for complaint. Automobile gasoline is at the bottom of nearly all of the carbon formation trouble, it being the case that this type of gasoline volatilizes but slowly at best, and, unfortunately, it is a fault of carbureters in general to deliver an excess of gasoline at the higher range of speed if the amount of the gasoline is in the right proportion at the low speed. For the purpose of illustrating the lack of volatility of automobile gasoline all that is necessary is to take a blow-torch, as shown in Fig. 44, fill it with automobile gasoline, light the torch in the regular way and set it down in front of a plate at a distance of four or five feet from the same, and then by turning on the gasoline so that it squirts out with considerable pressure it will be found that the more volatile fractions of the liquid will burn, and the less volatile parts will strike the plate and fall down to the ground without burning at all. If this less volatile product is collected in a pan until there is a considerable amount of it, and it is then allowed to cool off, as a further proof of its non-volatile properties a piece of newspaper may be set on fire and thrown into this pan of liquid, only to find that it will quench the flame. The non-volatile part of the average automobile gasoline mixture is not far from 50 per cent. of the whole content.

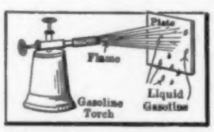


Fig. 44—A gasoline torch employed in an experiment to observe the volatility of gasoline

Automobile Gasoline Is Composed of Several Fractions of the Distilling Process.—If the automobilist will go to a wholesale chemist's establishment and purchase several samples of the hydro-carbon products, each varying in specific gravity from the other, and thereafter spill an equal amount of the respective fractions in dishes, as shown in Fig. 45, he will find that the product of the lowest specific gravity, if placed in the dish G, will vaporize quicker than the product of the next highest specific gravity, as placed in the dish BC, and the same rule will apply to the dish BB, and BA, but the heaviest product, if placed in the dish K, will scarcely volatilize at all. This simple test merely goes to show that a composite mixture of all these distillates if used as automobile gasoline will give trouble in various ways unless the means at hand for its proper use take into account the fact that the lighter fractions will vaporize out of the body of the liquid, leaving the heavy residuum.

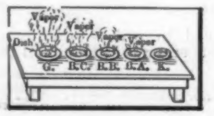


Fig. 45—Dishes on a table filled with hydro-carbon liquids of different weights, measuring the rate of evaporation

Hydrometer Test of no Value From the Automobilist's Point of View—In going to a wholesale chemist for samples of the several fractions of the distilling process it would be with the expectation that these specimens would run hexane for the more volatile material, heptane for the next in the scale, and then in the order of increasing specific gravity to octane, nonane, decane, etc. This rule would not hold in the case of automobile gasoline; the several fractions would be present in various percentages, which the hydrometer would fail to disclose, and referring to Fig. 46, of a chemist's balance, if gasoline could be weighed in the manner as indicated, the hexane, which responds to the formula C_6H_{14}, it would be found that the quantity of the commercial sample of automobile gasoline required to balance the scale against a standard sample of hexane would be a less bulk than the hexane, but the scales would fail to tell the proportions of the fractions in the makeup of the commercial sample of gasoline. The only way that the percentages of the fractions that compose automobile gasoline can be ascertained is in the fractional distilling process, which is too intricate for an automobilist to undertake.

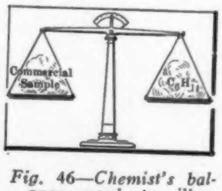


Fig. 46—Chemist's balance used to illustrate the weight of true gasoline as compared with automobile gasoline

How Coke Is Made Out of Automobile Gasoline—In the ordinary course in coke burning, wood is put in a chamber and hermetically sealed, after which a fire is built in the grate under the chamber, and the wood is subjected to a distilling process, removing the volatile portion, and the product is coke. This process is shown in Fig. 47. To the average man it is difficult to understand that coke can be made out of a liquid as well as out of a solid. In the meantime, there is far more carbon in gasoline than there is in wood. It is a mere trick of nature to float over 80 per cent. of the carbon, which is the solid constituent of wood, in a liquid with hydrogen as the remaining constituent, but when this liquid, with its major content of carbon, is heated up in the absence of oxygen, the liquid "cracks" and the carbon is precipitated. When gasoline is mixed with air and placed in the combustion chamber of a motor, unless the air is in excess of the theoretical right amount for complete combustion, the part of the carbon that fails to find its oxygen mate will form into coke, and it will drop down on to the piston head or adhere to the combustion chamber walls, as shown in Fig. 48. How much carbon of the total that will precipitate out in the ordinary course depends (a) upon the proportion of air to gasoline, and (b) upon the volatility of the gasoline. In these days, when a considerable percentage of the gasoline is of the heavier constituents, the tendency to the formation of coke in the manner as above described is accentuated, and this is all the more reason for desiring that the carbureter shall more perfectly mix the air and the gasoline, maintaining the ratio of these two media in the strictest conformity with the conditions of combustion that will result in the complete burning of the carbon, preventing the formation of coke.

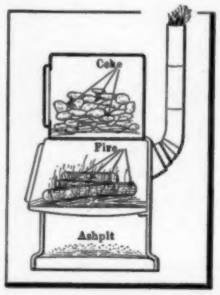


Fig. 47—Section of an oven illustrating the method of making coke, distilling off the volatile products

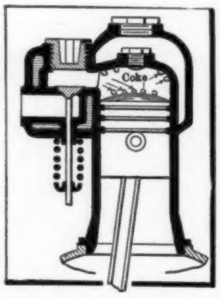


Fig. 48—Section of a cylinder used to illustrate the making of coke out of hydro-carbon liquids in a motor

Incomplete Scavenging Is at the Bottom of Some of the Poor Performance of Motors—The time available for the removal of the products of combustion after the power stroke in the motor is too short to permit of complete scavenging in any case. How to realize the best possible condition of scavenging is the remaining problem. In view of the fact that the piston does not sweep the whole space, some of the mixture, after it is burned, must depart under the force of its terminal pressure. After the terminal pressure dies out the part of the gas that is usually left behind is that which accounts for the bad scavenging relation complained of. It has been found in practice that the scavenging condition may be improved by using a small-diameter pipe between the transfer port on the exhaust side of each cylinder of the motor, and a receiver, as shown in Fig. 49. In this plan, owing to the small diameter of the connecting pipe, the speed of the departing exhaust product is accelerated, and the exhausting "fluid" is compacted, and not unlike the performance of a "comet," the gas molecules persist in accompanying each other on the journey, and the tail of the gas body (comet) follows the head, and in this way the rarefied gas in the com-

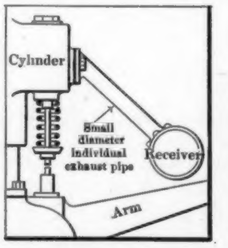


Fig. 49—Part of a cylinder showing a small diameter pipe on the exhaust side leading to a receiver

bustion chamber at the tail end of the exhausting period follows in the train of the departing "fluid," thus more or less completely scavenging the space. It has been found under certain well defined conditions that a vacuum will reside in the cylinder after the exhaust leaves, which vacuum very readily fills with the incoming mixture, and the performance of the motor from the power and thermal efficiency point of view is thereby much enhanced.

Plan for Getting Rid of Non-Volatile Liquid—The scavenging problem is always more or less seriously interfered with on account of the presence of the heavier constituents of the hydro-carbons, and it has been suggested that the non-volatile portions of the liquid that entrains in the incoming air may be separated out in the manner as shown in Fig. 50, which is an ordinary trap incorporated into the intake manifold in the same way that is employed in the separating of water from steam in the operation of steam engines. The liquid, in globule form, as it sweeps up through the manifold from the carbureter impinges on the baffle plate that partly obstructs the passage of the mixture, and falls down into the cavity that is formed as the section shows, and passes through the hole at the low point into the pocket below, from whence it cannot escape excepting through the draincock in the bottom of the pocket. If some of this liquid is volatile it will vaporize in the pocket, and the vapor so formed will pass up through the hole in the bottom of the depression and mingle with the train of incoming mixture, in which form it serves as fuel, and the idea of economy is thereby perpetuated in this plan.

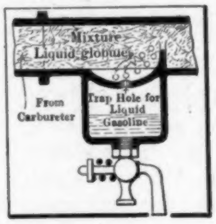


Fig. 50—Section of an intake manifold showing a trap for the non volatile liquids

Cylinder Lubrication Is Attended by Difficulties—The presence of a good carbureter on a motor is essential to the success of the undertaking, but however well contrived the carbureter may be, it will be of small avail if the mixture is unbalanced between the time that it leaves the carbureter and the instant when it departs from the cylinder on the scavenging stroke. If it may be assumed that the gasoline phase of the problem is well cared for, it remains to examine into the use of the fuel, and the first thing to consider from this point of view is the fact that the mobility of the lubricating oil should be constant. The idea of mobility is illustrated in Fig. 51, showing two hogsheads holding molasses, and for the sake of argument let it be assumed that one hogshead is having its molasses run off in January and the other one in July. That the January molasses will run slow is a well appreciated fact, and that the July molasses will be attenuated follows in view of the difference in temperature. The reason for this performance lies in the lack of mobility of the molasses; it thickens up when it gets cold, and it thins down when it is heated up. If lubricating oil has this property it is lacking in value for cylinder lubricating work. Lubricating oil that has an undue tendency to thin out when it is heated is likely to flash at the high temperature that obtains in a motor cylinder; moreover, in view of the fact that piston rings are rarely ever actually tight, it is but a step to the conclusion that lubricating oil of a constant mobility, if it is initially of the right consistency will serve as a packing for the piston rings and prevent leakage of the combustible from the combustion chamber around the rings into the crankcase.

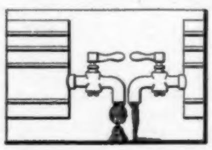


Fig. 51—Illustrating the mobility of liquids as they are affected by temperature

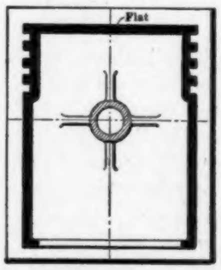


Fig. 52—Section of a flat-top piston as used in some types of motors

Thermal Efficiency Will Be High or Low, Depending Upon the Shape of the Chamber—In explaining the excellent performance of a motor, it is common practice to refer to the general design of the same, and to attribute the excellent performance to the type of motor without noting the details of the design. No matter what type of motor is employed the performance will be mediocre unless the details of design are fittingly contributed. The amount of heat that will escape from the combustion chamber to the water jacket and the exterior generally depends upon (a) the temperature residing within, and (b) the area of the flame-swept surface. The area of the flame-swept surface will depend upon the shape of the combustion chamber and the contour of the piston head. If the combustion chamber is domed spherically the area will be the minimum. Other shapes are less efficient in this regard. Referring now to the heads of the pistons, Fig. 52 shows a flat head, offering the largest area and the greatest tendency to disrupt. Fig. 53 presents a slightly elliptical bulge, which is much used in practice in conjunction with spherical heads of the combustion chamber, affording about the right compression space. Fig. 54 is a plan that is difficult to use because it infringes upon the combustion space and requires the distortion of the dome of the cylinder proper beyond the ordinary necessity, and Fig. 55 is the reverse of Fig. 54, and while the idea has been used, it interferes with the proper adjustment of the combustion chamber space, and is scarcely to be used under the conditions of compression that obtain for automobile gasoline.

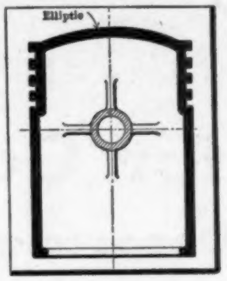


Fig. 53—Section of a piston with a slightly elliptical head which is in common use in motors

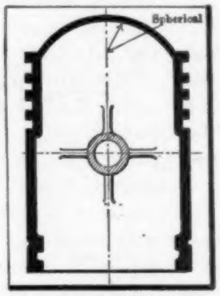


Fig. 54—Section of a piston with a spherical head which is used in a few motors

Poorly Contrived Splash Systems Upset the Mixture Balance—While it is recommended that the amount of lubricating oil used be sufficient for every purpose the fact remains that there is a great difference between profuse lubrication and an uncontrollable splash. Fig. 56 shows a section of the lower half of a motor case, and a lubricating oil throw of the connecting rod head, showing the scoop on the cap dipping in the lubricating oil, and the level that the oil assumes when the automobile is traversing a grade or slipping down a hill is shown by dotted lines. This system might be designated as a controlled splash, but if the lubricating oil rests in the bottom of a pan it will pile up at the low point, excepting when the automobile is traversing a level, hard road, and excesses of the lubrication will be splashed furiously against the walls and up into the piston, and some of this excess oil will be sucked by the piston rings during "inspiration," resulting in the unbalancing of the mixture and a troublesome series of incidents, not among the least will be mentioned carbon formations in the combustion chamber on account of the glue-like consistency of the deposit so formed, and the fact that silicon and other earthy dusts which come in with the mixture will be arrested in their migration and will add to the cement-like formation that ordinarily passes current as a carbon deposit. The motor will soon indicate a cranky condition of performance under these circumstances, and far too soon preignition will be the last stage of a much-dreaded disorder.

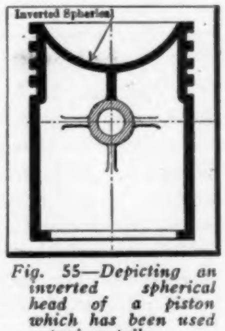


Fig. 55—Depicting an inverted spherical head of a piston which has been used experimentally

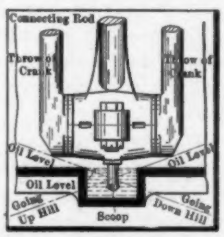


Fig. 56—Section of the lower half of a crank case showing an oil channel accommodating the scoop on the end of the connecting rod

Proper Scavenging Depends Upon Good Valve Timing—If, after proper precaution has been taken in the devious ways, a motor persists in acting in an unruly manner it will be worth while to examine the timing of the valves and to see if they open and close as they should. In the taking down of the motor, since the halftime gears have to be unmeshed, workmen of poor skill forget to mark the meshing teeth in the manner as shown in Fig. 57, by means of spotting with a tool at A for the magneto gear, and B for the halftime gear, and when the motor is reassembled workmen of this type use their imagination, hoping that they will arrive at the proper meshing of the teeth, but the process is futile. The gears should be properly marked before the teeth are unmeshed, but if this ceremony is dispensed with and the motor performs in an ugly way after it comes back to the owner from the repair-shop it will remain for him to investigate the setting of the gears and the timing of the magneto, when, if he finds that the teeth of the halftime train are wrongly meshed, he will have to remesh the gears to accord with the obvious needs, and it is suggested here that he take a spotting tool while the opportunity affords and do the work that the repair-man is in duty bound to complete if he renders a bill for a proper undertaking.

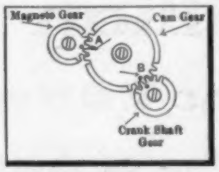


Fig. 57—Plan of the half-time gears showing how they should be marked to keep track of the meshing teeth

A Weak Ignition May Be at the Bottom of a Poor Performance—In the canvass of the motor situation it is not enough to rely upon a mere magneto as being a fitting source of the ignition work. In the course of time the magnetism of the permanent magnets of the magneto recedes sufficiently to warrant having these members remagnetized. Figure 58 presents a diagram of an easy plan whereby the owner of an automobile may take the magnets off the frame by the simple expedient of unscrewing the holding bolts, and after winding a coil of perhaps a hundred turns of No. 18 B. & S. double cotton-wound magnet wire, which is always of copper, the coil is slipped over one leg of each permanent magnet in the process of remagnetizing and the two ends of the coil may be attached to the terminals of the storage battery, making one of them fast and holding the other end of the magnet wire in the hand, making contact, after which the circuit is broken by drawing the wire slowly away from the terminal of the battery. A half-dozen applications of the current in this way will suffice to remagnetize the members of the magneto, and they may then be screwed back into place, after which the magneto should perform its function of generating current for ignition purposes fittingly.

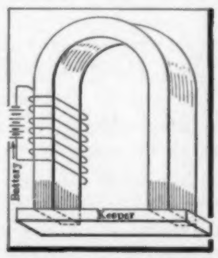


Fig. 58—Diagram showing the method employed in the remagnetizing of the permanent magnets of the magneto

Ordinary Tools Will Not Suffice for Automobile Work.—An ordinary lathe, while it may be regarded as capable of doing general work at a convenient rate of speed, is entirely too weak to stand up against alloy steel, particularly when the cutting tools are high-tungsten product, and the speed of cutting is all the way from 60 to 100 feet per minute. Lathes as they were designed originally, and as they obtain under conventional conditions, are capable of machining cast iron at perhaps 20 feet per minute for the speed of cutting; they will do this work with excellent accuracy, but the tensile strength of cast iron is maximum at 30,000 pounds per square inch, whereas the tensile strength of many of the grades of steel used in automobile work reaches above 80,000 pounds per square inch, and 100,000 pounds tensility is not unusual. In the case of cast iron, the elongation is normal, whereas in the better grades of alloy steel it is not far from 25 per cent. in 2 inches of a 1-2-inch test proof. Account must be taken also of the elastic limit of alloy steel. In some of the product this factor reaches as high as 80,000 pounds per square inch, whereas the elastic limit of cast iron is very low.

Obviously, lathes, or in fact any generic type of tool, which may have been designed to handle cast iron, or even the mild grades of machinery steel, as formerly utilized in structural work, are bound to fall below a fitting requirement when high-class automobiles are to be manufactured.

A Million a Day for Good Roads

This Is the Estimate of the Department at Washington

Touring Club of America Participates in Good Roads Movement

According to Dr. Logan Waller Page, Director of the Office of Public Roads, of the Department of Agriculture, Washington, this should prove a banner year in road building in the United States. A greater sum is available for roads in 1911 *than ever before. Funds have been raised by private subscription, local taxation, bond issues, and State appropriations, aggregating the stupendous total of* $140,589,356. *Exclusive of Sundays and legal holidays, this sum will average about* $1,000,000 *a day during the road-building season, and even a greater sum than this may be available, as many counties are agitating bond issues and will, no doubt, vote favorably upon them during the year. The funds available at present in the different States are as follows:*

Alabama—Bonds have already been voted in Alabama to the amount of $1,330,000, and Jefferson County is to vote on an issue of $1,000,000. The recent Legislature passed a law creating a State Highway Department, and making an annual appropriation of $154,000, to be expended for State-aid. In addition to this, the regular funds of the various counties will amount to probably another million dollars, making an approximate total for the State of Alabama of $3,484,000.

Arizona—The territorial road fund for 1911 will be approximately $200,000. This fund is derived from a tax levy of 25 cents on each $100 of assessed valuation in counties covered by the proposed territorial highway system and 5 cents on each $100 in counties not covered by the proposed system. In addition, local funds by counties are raised in varying amounts, and will probably be sufficient to increase the road expenditures in Arizona to $500,000 for the year.

Arkansas—Information concerning road expenditures in the State of Arkansas is very meager, but the total amount expended for roads in that State in 1904 was $1,395,342.80. It is reasonable to suppose that this amount has increased since that date sufficiently to assume that the expenditures this year will equal $1,500,000.

California—The State of California ranks first among the States in the amount it proposes expending on its roads. San Joaquin County has issued and is expending $1,800,000 on its roads, and San Diego County $3,000,000. At the general election in November, 1910, a proposition was favorably voted upon by the people of the State for the issuance of $18,000,000 of State bonds for road purposes. In addition to this, the local revenues should amount to $3,000,000.

Colorado—Colorado is following closely in the wake of California by agitating a constitutional amendment authorizing the issuance of $10,000,000 in State bonds for road improvement. Fifty thousand dollars will be available from the automobile license fund, and, in addition, it is proposed to appropriate $700,000 or expenditure by the State Highway Commission during 1911-1912. This appropriation, however, has not yet been made. The local revenues of Colorado will probably amount to $1,000,000.

Connecticut—The State appropriation for Connecticut has not yet been made, but will probably amount to something like $2,000,000. Last year the State appropriated $550,000 for trunk line roads and $1,725,061.84 for State-aid roads, making a total of State appropriations for 1910 of $2,275,061.84. In addition to this, the local appropriations amounted to probably an equal sum. These appropriations will not be any less for 1911, and in all probability will be increased. A bill is also pending before the Legislature proposing an issuance of $3,000,000 of State bonds, $1,000,000 to be used for the construction of State roads, with the aid of the towns, and $2,000,000 to be used for the construction of trunk line roads by the State, independently of the towns.

Delaware—$30,000 is appropriated by the State of Delaware, which is to be duplicated by the counties. In addition, the regular county road funds will amount to probably $100,000, and it is proposed to issue $200,000 worth of bonds in New Castle County. Various propositions are before the Legislature, looking toward appropriations for constructing State roads, one involving a loan of $750,000 to the State by Mr. T. B. Rogers, and another involving a contribution of $1,000,000 toward the construction of State roads by Mr. T. C. Dupont. In addition, the local revenues should amount to $100,000.

Florida—No appropriation is made by the State for road purposes in Florida, but $755,000 in bonds are available for expenditure this year by the following counties:

Dade	$150,000
Manatee	250,000
Putnam	155,000
St. Lucie	200,000

In addition, the local revenues by counties for road purposes should amount to fully $750,000.

Georgia—In Georgia both State and county convicts are worked on the roads. There are at present 4,618 convicts at work on roads in the State. Very few counties have issued bonds, but Floyd County contemplates the issuance of $200,000 in bonds—and there may be others. The local revenues of counties for the year will amount approximately to $2,500,000.

An association was organized on March 31, 1911, at Tifton, Ga., to be known as the Central Route Association of the Journal-Herald National Highway. The object of this association is to promote the construction and maintenance of a high-class road along the central route of the proposed national highway, from New York to Jacksonville, via Atlanta, Ga.

Idaho—The recent Legislature of Idaho appropriated $53,000 from the State treasury for constructing State roads. This will be supplemented by local road funds, which will approximate $500,000.

Illinois—The State of Illinois maintains a State highway department, and works convicts in the preparation of road building materials, which are furnished to the various counties f. o. b. the rock crushing plants. The appropriation for the State Highway Commission was $65,000 in 1910, and there will probably be a like one made for 1911. The local funds to be raised by counties and townships will amount to $5,000,000 or more.

Indiana—The State of Indiana contributes in no way toward the road movement. All funds are raised locally by counties and townships, and will probably be not less than $4,500,000 for 1911.

Iowa—The State College at Ames, Iowa, is required by law

to act as the State Highway Commission for the State. No money is appropriated from the State treasury for this purpose, the expenses being paid from the general fund of the college. The local road revenues throughout the State for this year will probably amount to $3,500,000.

Kansas—$93,356 in bonds have been issued by various counties and townships for expenditure on roads in 1911. In addition to this, the local road revenues of counties and townships will amount to $1,500,000.

Kentucky—The State of Kentucky makes no appropriation for roads, and road bonds are rarely issued by counties. One or two counties are to vote on bond issues, or have voted, but the results are not known. The local road revenues should amount to probably $2,500,000.

Louisiana—The State of Louisiana has a tax of one-quarter of a mill on each dollar of taxable property for road purposes. This yields a fund of $132,354.86. In addition, the surplus revenues of the State Fish and Game Commission are applied to the State road fund, and the local revenues will exceed the amount of $1,000,000.

Maine—The State-aid appropriation for 1911 is $250,000, and in addition to this, the local road revenues will amount to approximately $2,000,000.

Maryland—Maryland has available for building trunk line roads during this year $1,050,000, which is derived from the sale of State road bonds, $5,000,000 of which was authorized in recent years. There is available for State-aid in 1911 $200,000, making a total of $1,250,000 from the State, and the local road revenues should amount to $1,000,000, making a total of $2,250,000. In addition, Baltimore county is to vote on a $1,500,000 bond issue this Fall.

(*Continued on page* 1150.)

Calendar of Coming Events

Handy List of Future Competitive Fixtures

Race Meets, Runs, Hill-Climbs, Etc.

May 16-19	Washington, D. C., Four-Leaf Clover Endurance Run, Automobile Club of Washington.
May 22	Brooklyn, N. Y., Reliability Run, Long Island Auto Club.
May 24	Birmingham, Ala., Hill Climb, Birmingham Motor Club.
May 24	Lancaster, Pa., Three-Day Endurance Run, Lancaster County Auto Trade Association.
May 24	Los Angeles, Cal., Commercial Vehicle Run, Los Angeles *Examiner*.
May 25	Chicago, Ill., Fuel Economy Test, Chicago Motor Club.
May 27-31	Chicago, Ill., Five-Day Tour to Indianapolis, Chicago Automobile Club.
May 29-31	Chicago, Ill., Tour to Indianapolis, Chicago Motor Club.
May 30	Camden, N. J., Track Races, South Jersey Motor Club.
May 30	Denver, Col., Track Races, Denver Motor Club.
May 30	Indianapolis, Ind., Five-Hundred-Mile International Sweepstakes, Motor Speedway (Circuit).
May 30	Lakeside, Cal., Track Races.
May 30	St. Louis, Mo., Reliability Run, Missouri State Automobile Association.
June 7	New York City, Orphans' Day.
June 8	Algonquin Hill Climb, Chicago Motor Club (Circuit).
June 10	Philadelphia, Track Races, Philadelphia Auto Trade Association.
June 10	West Haven, Conn., Shingle Hill Climb, Automobile Club of New Haven and Yale Automobile Club.
June 10	Philadelphia, Reliability Run for Electrics, Quaker City Motor Club.
June 10-11	Chicago, Ill. (Hawthorne), Track Races.
June 13-14	Milwaukee, Wis., Track Races, Fair Grounds (Circuit).
June, 15, 16, 17	Dayton, O., Midsummer Meeting Society of Automobile Engineers.
June 15-20	Endurance Run, Cañon City, Col., to Hutchison, Kan.
June 17	Ossining, N. Y., Hill Climb, Upper Westchester Auto Club.
June 17	Portland, Me., Hill Climb, Maine Automobile Association.
June 19	Des Moines, Iowa, Annual Tour, Hyperion Field and Motor Club.
June 21-29	Glidden Tour, Washington, D. C., to Ottawa, Canada.
June 20	St. Louis, Mo., Reliability Run, Auto Club of St. Louis.
June 24	New York, Track Races, Brighton Beach (Circuit).
June 24	Philadelphia, Hill Climb, Quaker City Motor Club.
June	Denver, Col., Reliability Run, Denver Motor Club.
June	Norristown, Pa., Hill Climb, Norristown Auto Club.
June	Oklahoma, Reliability Run, Oklahoma Auto Association.
July 1	Riverhead, L. I., Road Race (Circuit).
July 1-3	Motor Contest Association's Catskill Run.
July 4	Detroit, Annual Track Meet, Wolverine Automobile Club.
July 4	Bakersfield, Cal., Road Race, Kern County Merchants' Association.
July 4	Denver, Col., Track Races, Denver Motor Club.
July 4	Port Jefferson, N. Y., Hill Climb (Circuit).
July 4	Worcester, Mass., Hill Climb (Circuit).
July 7	Taylor, Tex., Track Races, Taylor Auto Club.
July 8 or 15	Philadelphia, Track Races, Belmont Park; Norristown Auto Club.
July 12	Indianapolis, Indiana Four-State Tour, Indianapolis Auto Trade Association.
July 14	Philadelphia, Commercial Reliability Run, Quaker City Motor Club.
July 17-19	Cleveland, O., Three-Day Reliability Run of the *Cleveland News*.
July 17-22	Wisconsin Reliability Run, Wisconsin State Automobile Association.
July 29	Philadelphia, Track Races, Belmont Park (Circuit).
July	Amarillo, Tex., Track Races, Panhandle Auto Trade Association.
Aug. 1	Chicago, Ill., Commercial Reliability Run, Chicago *Evening American*.
Aug. 12	Detroit, Track Races, Fair Grounds (Circuit).
Aug. 12	Philadelphia, Reliability Run, Quaker City Motor Club.
Aug. 25-26	Elgin, Ill., National Stock Chassis Road Race, Chicago Motor Club (Circuit).
Aug.	Los Angeles, Cal., Track Races, Motordrome.
Sept. 1	Chicago, Ill., Commercial Reliability Run, Chicago Motor Club.
Sept. 1	Oklahoma, Reliability Run, *Daily Oklahoman*.
Sept. 4	Denver, Col., Track Races, Denver Motor Club.
Sept. 4	Indianapolis, Track Races, Motor Speedway (Circuit).
Sept. 7-8	Philadelphia, Track Races, Philadelphia Auto Trade Association.
Sept. 8	St. Paul, Minn, Track Races, State Fair (Circuit).
Sept. 12-13	Grand Rapids, Mich., Track Races, Michigan State Auto Association.
Sept. 15	Knoxville, Tenn., Track Races, Appalachian Exposition.
Sept. 16	Syracuse, N. Y., Track Races, State Fair (Circuit).
Sept. 23	Lowell, Mass., Road Race (Circuit).
Oct. 3-7	Danbury, Conn., Track Races, Danbury Agricultural Society.
Oct. 7	Philadelphia, Fairmount Park Road Race (Circuit).
Oct. 9-13	Chicago, Ill., Thousand-Mile Reliability Run, Chicago Motor Club.
Oct. 16-18	Harrisburg, Pa., Reliability Run, Motor Club of Harrisburg.
Oct. 19-21	Atlanta, Ga., Track Races, Speedway (Circuit).
Oct.	Denver, Col., Track Races, Denver Motor Club.
Nov. 1	Waco, Tex., Track Races, Waco Auto Club.
Nov. 2-4	Philadelphia, Reliability Run, Quaker City Motor Club.
Nov. 3	Savannah, Ga., Light Car Road Race (Circuit).
Nov. 7-10	Los Angeles-Phoenix Road Race, Maricopa Auto Club.
Nov. 9-11	San Antonio, Tex., Track Races, San Antonio Auto Club.
Nov. 10	Phoenix, Ariz., Track Races, Maricopa Auto Club.
Nov. 30-Dec. 2, 3	Denver, Col., Hill Climb, Denver Motor Club.
Dec. 25-26	Los Angeles, Cal., Track Races, Motordrome.

Foreign Fixtures

May 21	Limonest, France, Annual Hill-Climb.
May 21	Ries, Austria, Hill-Climb.
May 21	Meuse Hill-Climb, Belgium.
May 25	Barcelona, Spain, Catalona Cup Road Race.
May 25	Le Mans, France, Touring Car Kilometer Speed Trials.
May 28	Le Mans, France, Hill-Climb for Touring Cars.
May 28	Start of Touring Car Reliability Trials in Germany.
June 1	Bucharest, Roumania, Speed Trials.
June 4	Trieste, Austria, Hill-Climb.
June 18	Boulogne, France, Voiturette and Light-Car Road Races.
June 25-July 2	International Reliability Tour, Danish Automobile Club.
July 5 (to 20)	Start of the Prince Henry Tour from Hamburg, Germany.
July 9	Sarthe Circuit, France, Grand Prix of Automobile Club.
July 13-20	Ostend, Belgium, Speed Trials.
July 21-24	Boulogne-sur-Mer, Race Meet.
Aug. 6	Mont Ventoux, France, Hill Climb.
Sept. 2-11	Roubaix, France, Agricultural Motor Vehicle Show.
Sept. 9	Bologna, Italy, Grand Prix of Italy.
Sept. 10-20	Hungarian Small-Car Trials.
Sept. 16	Russian Touring Car Competition, St. Petersburg to Sebastopol.
Sept. 17	Semmering, Austria, Hill-Climb.
Sept. 17	Start of the Annual Trials Under Auspices of *l'Auto*, France.
Oct. 1	Gaillon, France, Hill-Climb.

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STORIES circulate in the haunts of the supporters of the automobile industry relative to the ultimate selling price of automobiles, and the question arises as to whether or not popular prices, so called, will fall to a low level or stay where they are at the present time. The law of probability has maintained its status through history, and it is more than likely that "probability" is the only law that users of automobiles can accept as their very own. It can easily be shown that a high price will bring either a good or a bad automobile, and statistics also prove that a low price offers its choice of a good or a bad automobile. Good and bad as used here are not to be construed literally, being merely relative terms.

* * *

TO bring the picture of the relative into better prominence it may be stated that a good automobile ten years ago was an inferior product as compared with a bad automobile of to-day. The law of probability says that a good automobile of to-day will be a bad one of to-morrow. It will be understood that to-morrow does not mean the day after THE AUTOMOBILE goes to press, or next week, or the week after that, but it does mean the automobile-construction to-morrow; in other words, the dawn of the day which marks the birth of a new era under the impetus of the law of evolution; but even this law is subservient in every instance to the law of probability.

MISTAKEN notions abound among those who have not studied the "overhead" in plants, and too much prominence is attached to the influence of the cost of the finer grades of material upon the selling price of the automobiles so made. As a general proposition the "overhead" in the plant of a progressive maker must include an addition of 10 per cent. to the cost of material, but the cost of labor must be multiplied by two.

* * *

IF the finer grades of material exact extra labor in the machining processes, the law of probability predicts a certainty. The mere extra cost of the superior material will sink into insignificance in the face of the extra labor, due to the fact that 100 per cent. has to be added to the labor item in summing up the total of cost. Contrasting this big influence with the smaller increment that necessity adds to the value of the raw material to cover the cost of carting and storing the same, and the deduction is obvious.

* * *

IN the early days of the automobile industry machine tools were "raw" as compared with the requirement from the point of view of the fashioning of alloy steels, and the highest types of automobiles made under such conditions reflected a considerable "overhead," due to the poor showing that the machine tools made, following the extra measure of labor, substituting the latter in the absence of machine-tool quality. Ten years of experience under high pressure conditions has brought about a reform of the machine-tool proposition, and the labor increment to-day is scarcely more in the machining of alloy steel than it was ten years ago in the machining of cold-rolled steel.

* * *

IMPROVEMENT has not been confined to machine-tools. The law of probability has made its mark upon the men who do the work. In this phase of the undertaking the law is expressed in habit acquired. Men get used to doing the type of work for which they express individual preference, and habit fastens its coil around them, fettering them so that their bent is concentrated, and if they learn to perform the operations for which they are responsible in a certain well-contrived way, habit gives them the facility of doing better work at a higher rate of speed, and remembering that 100 per cent. is added to the labor item, it remains to be seen that the habit of doing better work at a higher rate of speed has an enormous reducing influence upon the "overhead."

* * *

THAT success shuns failure is reflected by the very law of probability that seems to point to a praiseworthy culmination of effort in the automobile art, and an item of no little importance by way of success is buried in the ramifications of the steel industry, it being the case that alloy steel of the relatively fine grades, of which it may be said there was no trace ten years ago, is to be had at the present time at the price of basic open-hearth steel, to which must be added the mere cost of the alloying elements. The law of probability is shouting from the house-tops, and it says electric-steel may be had in billets to-day by the buyer of acumen at from $40 to $45 per ton, but if the steel is alloyed, the cost of the alloying elements must be added to this base price.

IN the leading article of this issue THE AUTOMOBILE presents to the public the first authentic and authoritative statement ever published with regard to the cost of solid tires in truck operation. Tire costs are a material element in the total cost of operation and consequently are of the utmost importance to the makers and users of automobiles and of interest to everyone who contemplates the use of trucks in the immediate or distant future.

* * *

THE story is based upon the life history of 1,000 tires that were used up in the course of business practice. Accurate data were kept as to each individual tire. The tires were the products of eight of the leading tire-makers of the United States. The scenes of the tests were laid in six typical American cities. The tests continued over a space of four years and covered more than 11,000,000 tire miles. Over 900 trucks of various kinds were used at one time or another during the period under observation.

* * *

CONDITIONS of pavements and grades were various and afforded a wide opportunity to give the tires an adequate test. In some of the cities the topography is flat and in others hilly; in some the pavements were good and in others the contrary condition obtained. All around it was exceedingly comprehensive in every factor and demonstrated the cost of tires used for business purposes with much clarity.

* * *

THE actual miles traveled by all the tires was 11,182,856. Thus the average mileage of each of the 1,000 tires was 11,182+. The cost of the tires was $49,593.65, which would make the per mile per tire cost .00443, or materially less than one-half cent a mile for each tire mile. The truck mile, which represents the cost of four tires for each mile, was .01772, about 1 3-4 cents. The ton-mile cost for tires proved to be .00774, approximately. This shows that the average load carried was slightly over 4,500 pounds.

* * *

THE tire that lasted longest out of the entire 1,000 was one of 36 inches diameter by 4 inches tread. This tire delivered a total of 33,476 miles; cost $56; lasted 46 months on the front left wheel of a two-ton electric truck. The experience of this tire was exceptional, as was proved by the average figures. The worst example was afforded by a 32x4-inch tire on a driving wheel on a one-ton gasoline truck that was run on part of its schedule at twenty miles an hour. This tire gave only 4,360 miles and cost $50.67.

* * *

THE main lessons learned from the test were these: Big wheels and big tires are more economical on the hills than are those of smaller size. Conversely, smaller wheels and lighter tires are more economical on the flat than are those of larger size.

* * *

LIKE the "One-Horse Shay," the ideal condition of truck tire operation is one in which all the tires wear equally, so that it will not be necessary to use up a new tire in order to get the last 1,000 miles of service out of the rest of the suit. This is proved to be bad practice all around, because the new tire gives the truck a slight list, which harms the mechanism and at the same time proves destructive to the tire itself. Interchangeable wheels, so manipulated that tires of similar condition and fitness for service can be used together, would go a long way toward solving this problem.

* * *

EXPERIENCE with the tires tested shows that the front wheels should be equipped with slightly heavier tires than those in common use. The rear tires generally were longer lived than those with which the steering is done.

* * *

QUALITY and service of a tire do not follow its price in money with strict exactness. The personal equation in driving is one factor that can never be reckoned with save by education of drivers.

* * *

ROAD conditions in each city should be scanned carefully to determine which size and kind of tire is most available for service in it.

* * *

SOLID TIRES of the same size often vary markedly even in the same make and there is a distinct difference between tires of similar size and separate makes.

* * *

ONE measure of tire life of any good variety and make is speed. High speed destroys tires. The average speed attained by the trucks under observation in this test was twelve miles an hour. The tires returned a service of 11,182 miles each at this average speed. In one city, where intelligent direction and stringent law prohibited high speed, a lighter type of tire cost only .0032 per mile, while the ton-mile rate was .0048.

* * *

AT the rate of speed recommended by the Manufacturers' Contest Association, 8 miles an hour, the data at hand shows that the average life of a tire would be 20,000 miles, or .0025 per tire mile. It has been shown that a speed of 20 miles an hour means only about 4,000 miles of tire life, or .0125 per tire mile. The difference between these two figures spells the distinction between success and failure.

* * *

AT the rate of twenty miles an hour the mechanical troubles would be immensely larger than they are at twelve miles and at twelve miles they are much larger than they would be if the rate of speed was limited strictly to eight miles an hour.

* * *

WHILE the operation of the automobile freight truck has been moderately successful at twelve miles an hour, and even at that rate of speed would eventually displace the horse, at eight miles an hour its effectiveness would be vastly larger and its maintenance and operation cost much less than at present.

Glidden Tour Outline for 1911

Through nine States and two provinces of the Dominion of Canada, the Glidden tour of 1911 will traverse 1,089 miles. The start will be from Washington, June 21 and the finish at Ottawa, June 29.

The date of the start was moved forward two days from the originally selected date in order to allow the tourists to spend Sunday in Boston. The hill climb, which will be an important factor in the tour, will be held on "Dead Horse" hill at Worcester, Mass., on Saturday afternoon, June 24.

The itinerary of the tour is as follows: Wsahington to Philadelphia, 163 miles with noon control at Bellaire. Philadelphia to New York, 182 miles, with noon control at Lakewood, N. J. New York to Springfield, Mass., 146 miles, with noon control at Waterbury, Conn. Springfield, Mass., to Worcester, 50 miles with hill climb on Dead Horse hill; thence to Boston, 40 miles. Sunday in Boston. Boston to Springfield, Vt., 142 miles with noon control at Keene, N. H. Springfield, Vt., to Burlington, 135 miles with noon control at Montpelier. Burlington to Montreal, 110 miles with noon control at Alburg. Montreal to Ottawa, 121 miles with noon control at Carillon. David Beecroft will officiate as referee. The entries close on June 1.

Exciting Races at Latonia

CINCINNATI, O., May 15—The most exciting automobile race meeting ever held in Kentucky closed yesterday afternoon at Latonia race track, just across the river from this city. All of the races were open to non-stock cars of Class C and Class D, which means that in the former they were not restricted as to weight and in the latter they might be of any power.

The winning cars included: E-M-F, Cino (3), Buick (2) and Firestone-Columbus.

Savannah Run a Big Success

SAVANNAH, GA., May 15—With forty-seven contesting cars, the run of the Savannah Automobile Club last week from this city to Charlotte, N. C., proved to be a big success. The course was to Augusta, to Columbia, S. C., where a hill climbing test was held in which fifteen of the contesting cars took part and thence to Charlotte.

Forty of the cars are said to have come through with perfect road scores, but the technical committee announced that there would be few if any perfect technical scores. Four gold medals and four cups were the prizes hung up.

S. A. E. Publishes a Bulletin

For the purpose of keeping its members in more intimate touch with one another and the society, the S. A. E. is issuing a neat little bulletin at stated intervals.

New Type of Fire Truck

This fire truck was placed in commission recently at North Braddock, Pa. It is a Packard truck chassis with special body and equipment supplied by Albert F. Leuschner of Homestead, Pa. The stepboards, tool boxes, hose basket and brass railings are rated as part of the body. The equipment includes porch ladder, roof ladder, 32-ft. extension ladder, axe, crowbar, rotary gong, two Babcock extinguishers and two 25-gallon brass chemical tanks. It is so designed as to carry additional tanks of larger capacity as well as standard fire hose. The cost of the special body and equipment complete is $1,180. The chief has the seat beside the driver and the other fire fighters are ranged on the running boards.

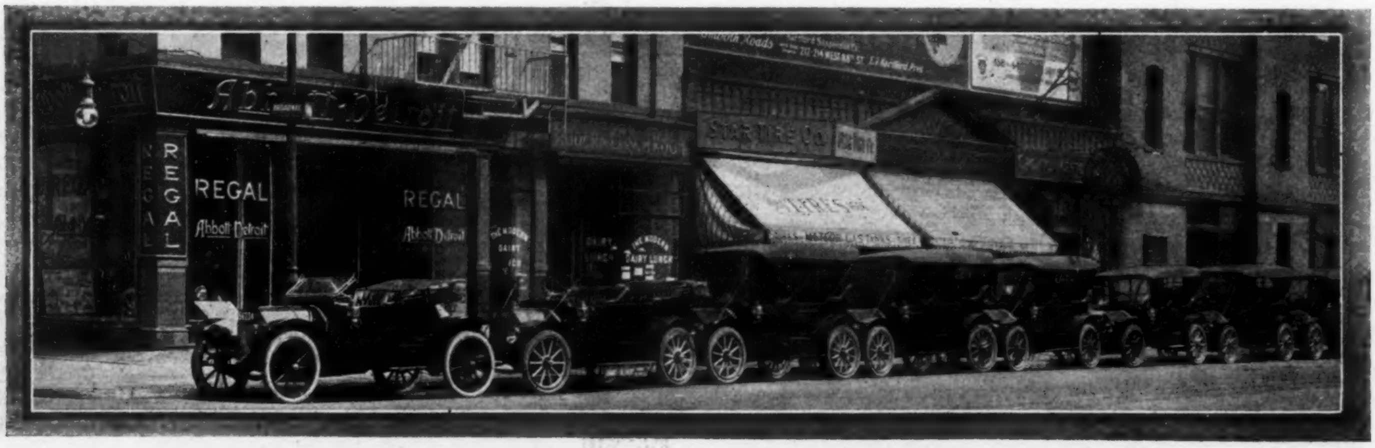
Packard fire truck recently placed in service at No. Braddock, Pa.

Coffin Outlines Value of Contests

Howard E. Coffin, president of the Hudson Motor Car Company and a leader of the Manufacturers' Contest Association, telegraphed his views on the subject of automobile contests to THE AUTOMOBILE as follows:

"DETROIT, MICH.—The Manufacturers' Contest Association is not a contest promoting body. The objects of the organization are the preparation of the proper rules for the government of all classes of contests and the support of the necessary machinery for clean-cut administration of the rules.

"The arrangement of racing dates in sequence as to time and place, is a logical arrangement from every standpoint. Under this arrangement a maximum number of entries may be assured; proper and experienced officials may be had and a minimum of expense will be incurred by the participants. Within the membership of the Manufacturers' Contest Association are those holding widely differing views as to the value of speed and endurance contests, but whatever may be the attitudes of the individuals, all are a unit in the knowledge that motor car con-

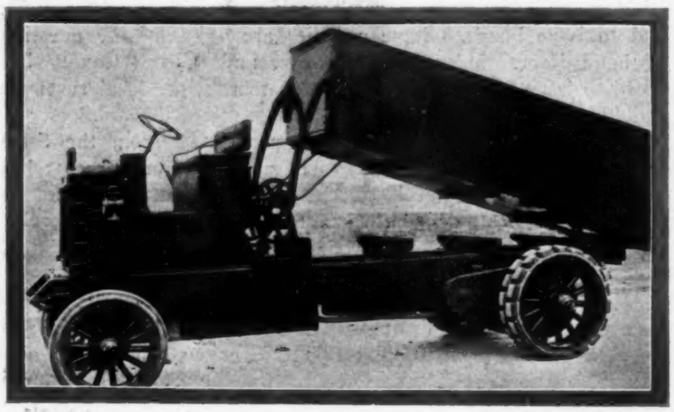


A pleasant indication of Spring prosperity in this block-long line of Abbott-Detroit Cars just delivered in New York.

tests are popular; that motor car contests are increasing in number yearly and that they must be properly governed with a strong hand.

"No class of men are cleverer to sound public sentiment than are State and county fair managers, and it is significant that motor car contests and races are being everywhere substituted as leading fair attractions, displacing the horse race which has held the popular fancy through the ages.

"Motor car racing has always been a clean sport and entirely free from the betting evil. The motor car contest has played a wonderful part in the mechanical perfection of the automobile. It has also played a wonderful part in publicity and as a popularizing agent. Perfection has not yet been reached in automobile design, materials and construction. Perfection has never been reached in any of the other mechanical arts. Clearly then the motor car contests of the present and future will teach metallurgists, designers and engineers lessons of the utmost value to both the manufacturer and user of the automobile."



Sampson 5-ton dumping truck, showing the raised body

Wolverines Expect 300 Starters

Detroit, May 15—Plans announced for the big run of the Wolverine Automobile Club of Detroit, June 22-28, give the affair even more scope than was originally attached to the mere decision of the club to hold the event. As the tour now shapes up, it will be an affair in which the clubs of at least two other cities will take parts as prominent as Detroit. Advices received from the Automobile Club of Buffalo and the Cleveland Automobile Club are of a most favorable nature, definite promise having been made of co-operation on the part of both organizations.

Chairman Harry R. Robinson of the Wolverine Club's runs and tours committee is inclined to the belief that the tour will be one of the largest on record, with from 200 to 300 cars in line.

Activity Among Book-Makers

The somewhat sparse state of the literature of the automobile art is being corrected in many particulars, and the types of books that are now being built for the edification of makers and users of automobiles are conspicuous in the light of a more exacting quality than that which obtained heretofore. Aviation, being a kindred art from certain points of view, is helping the situation marvelously, due to the fact that motors are being studied for aviation work, and it is a fortunate circumstance, perhaps, that these motors are founded on automobile practice.

STUDYING the gas engine on a broad basis is the plan of the most successful designer, and the new book entitled "Gas Engines," by W. J. Marshall and Captain H. R. Sankey, R. E., in what is known as the "Westminster Series" from the press of D. Van Nostrand & Company, New York,, should prove of unusual interest in this field of work. The book is plainly illustrated and is well-built, comprising 278 pages, including a comprehensive index, is bound in green cloth in imitation of pebble leather, with gilt lettering, and a substantial air which is normal to this print shop. The book opens with the author's note followed by a preface and a table of contents listing the illustrations so that they may be picked out readily, thus saving the reader time, and beginning with Chapter 1 the theory of the gas engine is discussed with fitting brevity and exact clearness. While the book deals largely with the conditions that obtain in "stationary" practice, the fact remains that the automobile engineer will find it of considerable value to him. The user of automobiles will also be able to get much valuable information out of this book.

* * *

AVIATION is receiving the attention of the book-maker, and the latest manufacture is entitled "The New Art of Flying," by Waldemar Kaempffert, from the press of Dodd, Mead & Company, New York, comprising 291 pages, including index, bound in cloth, artistically embellished. The book opens "The Way Flying Machines Fly," and true to the caption, the author justifies the position that he takes, holding tenaciously to the ramifications of the main problem, treating each phase of the aviator's art in the proper order of sequence, adhering throughout to the pertinent and co-relating facts, thus placing at the disposal of the novice and the expert alike a work that should discipline the intellect and bring the reader up to date in this field.

* * *

SHOP practice and the routing of work for the purpose of obtaining the maximum of result lead the investigator into the difficult field of motion study. Conserving the energies is one phase of this study. Energy efficiency is a second interpretation, and the subject of motion study is given the breadth of

McIntyre Model XIV open-body delivery wagon, with drop-down tail-board, used for furniture delivery

comprehensive consideration in a work entitled "Motion Study" by Frank B. Gilbreth, with an introduction by Robert Thurston Kent, from the print shop of the D. Van Nostrand Company, New York, comprising 116 pages, including index, bound in green cloth board with gilt lettering. This book deals with the intricacies of the workman problem, indicating very clearly the distinction to be drawn between the effort that fatigues and the motions that produce result without undue depreciation of the operator's reserve of energy. In the plants of the makers of automobiles there are quite a number of men who are making a study of workman efficiency, and after a careful perusal they will net new ideas that will be valuable to them out of this book.

* * *

INTEREST centers in the private garage to an extent never before known, and owners of cars finding that it is less expensive to make provision for the storage and keep of their machines are keen in the search for examples of private garages of the class possessing a degree of utility and a measure of art. The latest book on this subject is entitled "Bradford's Garages and How to Build Them," from the press of the Bradford Architectural Co., Chicago. The book comprises 108 pages, is 8 x 11 in size and among the numerous illustrations there are a series of fine examples of well-arranged garages of cement construction with a variety of architectural effects that should meet with the approval of fastidious automobilists. The price of the book is $1.00.

The Wright Spark Plug

The Wright spark plug shown in the cut is one of several of the Wright productions. There are five in all of this model, the Wright automatic cleaner, the Wright open- and closed-end standard 3-4 inch and the Wright open- and closed-end metric. The type shown is the automatic cleaner. This plug in addition to possessing all the features of manufacture as the other models is so built as to clean out the soot and oil that may find its way between the electrode and the shell. This is effected by interposing an air chamber in the brass bushing and holes are drilled therein at an angle pointing toward the circularly wrapped sheet mica around the electrode. When the gases are compressed in the cylinder a similar compression takes place in the interior of the plug passing through the small holes. When the pressure is released the imprisoned gas forces itself out and carries with it any foreign substance that may have lodged on the electrode. India mica is used in the manufacture of these plugs, and this material extends down, being wrapped around the electrode, the lower ends being turned to prevent chipping and flaking while in use. The plugs are made by the New York Mica & Manufacturing Co.

Looking at the Wright automatic cleaning spark plug

Million a Day for Roads

(*Continued from page* 1145.)

Massachusetts—Massachusetts makes liberal contribution from its State treasury for highway work. $500,000 has been already appropriated by the Legislature for construction work, the appropriation for maintenance not having yet been made, but it will probably amount to $200,000. The net proceeds from automobile licenses are also applied to highway purposes, and this will amount to something over $300,000. In addition, the local revenues should amount to $2,500,000.

Michigan—The State of Michigan aids in the construction of roads through a system of State rewards. $150,000 is appropriated a year for this purpose. A law was passed recently, authorizing counties to organize road work under the county system, and to issue bonds. Some counties are agitating the question of bond issues under this new law, and Wayne County has voted to issue $2,000,000. In addition to this, the local revenues should amount to $3,500,000.

Minnesota—In 1910 Minnesota appropriated from the State treasury $115,000 for State-aid. The appropriation for 1911 has not yet been made, but it can be assumed that it will not be less than the 1910 appropriation, and most likely considerably more. In addition, the local road revenues in Minnesota should exceed $2.000.000.

Missouri—The State road revenues will amount approximately to $300,000. This fund is derived from a stamp tax and dram shop tax. In addition to this, the various counties are agitating bond issues and the local road revenues should amount to $2,500,000.

Mississippi—No State-aid is given by Mississippi. Lauderdale county recently issued $200,000 in bonds. The local revenues should amount to approximately $2,000,000.

Montana—No State appropriation is made in Montana for roads. The local revenues should amount to $500,000.

Nebraska—No money is appropriated by the State of Nebraska for road work, this matter being left entirely to the counties and subdivisions thereof. The local road revenues should exceed $1,000,000.

Nevada—No funds are appropriated by the State for road work in Nevada, and the local road funds amount to scarcely more than $50,000.

New Hampshire—For 1911 the Legislature of New Hampshire has appropriated $125,000 for State-aid, and $250,000 for constructing trunk line roads, the State paying all the cost. In addition, the local road revenues throughout the State should amount to over $1,000,000.

New Jersey—New Jersey is the pioneer State of the Union in participation in the work of road improvement. Its first State-aid law was adopted in 1892. The appropriation by the State for work during 1911 has not yet been made, but in 1910 $300,000 was so appropriated, and this amount will, no doubt, be considerably increased in the appropriation for this year. In addition, a bill has been pending before the Legislature to authorize counties to issue bonds for road purposes. The local revenues from taxes, etc., should amount to $3,500,000.

New Mexico—A tax of one mill is levied for road purposes, and this yields a fund of about $100,000. In addition to this, the territory furnishes convicts to work on certain specified roads and also the local revenues should amount to $200,000.

New York—The State of New York is spending more money on roads than any other State in the Union. A few years ago $50,000,000 in bonds were issued for this purpose, and each year the Legislature makes larges direct appropriations from the State treasury. The appropriation for 1911 has not yet been made, but in 1910 $2,500,000 was appropriated for State-aid, and $2,500,000 for trunk line roads, the total cost of which was paid by the State. In addition to this the local road revenues by counties should exceed $7,000,000.

North Carolina—North Carolina only appropriates $5,000 from

the State treasury for road purposes, which amount is expended under the State Geologist for advice and engineering assistance. Quite a number of counties, however, have issued bonds, and voted special road taxes for improving their roads. There have been either issued or contemplated $4,609,000 to date this year, and various other counties and townships are agitating the question. In addition to this, a large fund is raised by the regular county and local revenues, which should amount to as much as $2,000,000.

North Carolina has projected several important highways, traversing the length and breadth of the State, for road improvement. One of these, known as the Central Highway, is to run from Moorehead City on the Atlantic Ocean to Paint Rock, or to some point on the Tennessee line. The route of this road is now being surveyed, and it is expected that work will be commenced in the near future. In 1910 $2,088,000 worth of bonds were issued, and other road taxes amounted to $829,898.-28, or a total of $2,917,898.28 for 1910.

North Dakota—Very little is being done in North Dakota. No State appropriation is made, but the Legislature in 1909 created a good roads experiment station at Bismarck for the purpose of making experiments and investigations to determine the most economical and practical methods of road improvement for North Dakota. The local revenues, however, should amount to $1,000,000 for this year.

Ohio—From April 1 to December 1, 1910, thirty counties in Ohio issued bonds to the amount of $2,606,356, and during the same period fifty-six other counties of the State expended $1.-727,056, or a total of $4,333,412. The State appropriation for 1911 has not yet been made, but in 1910 this appropriation was $476,500. The local road revenues should amount to $6,000,000 additional. Various counties are to vote on bond issues but as yet no definite information is available.

Oklahoma—The State of Oklahoma is spending about $1,-000,000 on its roads.

Oregon—The State of Oregon makes no appropriation from the State treasury for State roads. There will be probably $2,000,000 raised from local taxes for this year.

Pennsylvania—Pennsylvania has not as yet made its appropriation for 1911. The State, however, appropriated $1,000,000 for State aid in 1910. A bond issue of $50,000,000 for the State is being agitated, and the local revenues should amount to $7,500,000.

Rhode Island—Rhode Island has not as yet made its appropriation for 1911, but $300,000 was appropriated in 1910, and this amount will most likely be increased during this year. The local revenues of Rhode Island should amount to $500,000.

South Carolina—No State appropriation is made in South Carolina. Marion County has recently issued $100,000 in bonds. The local road revenues for the State should amount to $1,000,000.

South Dakota—South Dakota makes no appropriation from the State treasury for roads. The road revenues from local taxation should amount to $500,000 each year.

Tennessee—Nothing is appropriated by the State in Tennessee for road purposes. There have been issued, however, for expenditure this year $1,400,000 in bonds, and the local road revenues from other sources should amount to $2,500,000.

Texas—While Texas makes no State appropriation for roads, yet large funds are raised locally. Approximately $1,600,000 in bonds have been voted by various counties already this year, and the local road revenues from other sources should be about $6,000,000.

Utah—Utah has not as yet made its appropriation for 1911, but $27,000 was appropriated in 1910. Not less than this amount may be expected for 1911. In addition the local road revenues should exceed $500,000.

Vermont—The Legislature of Vermont has appropriated $150,000 for State-aid from the State treasury during 1911. A State bond issue is also being agitated for the purpose of constructing trunk line roads. The local road revenues should amount to $1,000,000.

Virginia—In Virginia there is available from the State appropriation $250,000, and in addition both State and county convicts are worked on the roads. Several counties have issued bonds in large amounts. Wise County, $700,000; Tazewell. $625,-000; Lee, $364,000, and other counties to a total of $2,454,000. Staunton County is also to vote on an isue of $1,000,000 which would make a total of $3,454,000 in bonds. In addition to this the local road revenues should amount to $1,000,000.

Washington—In the State of Washington the local road revenues should amount to $2,000,000.

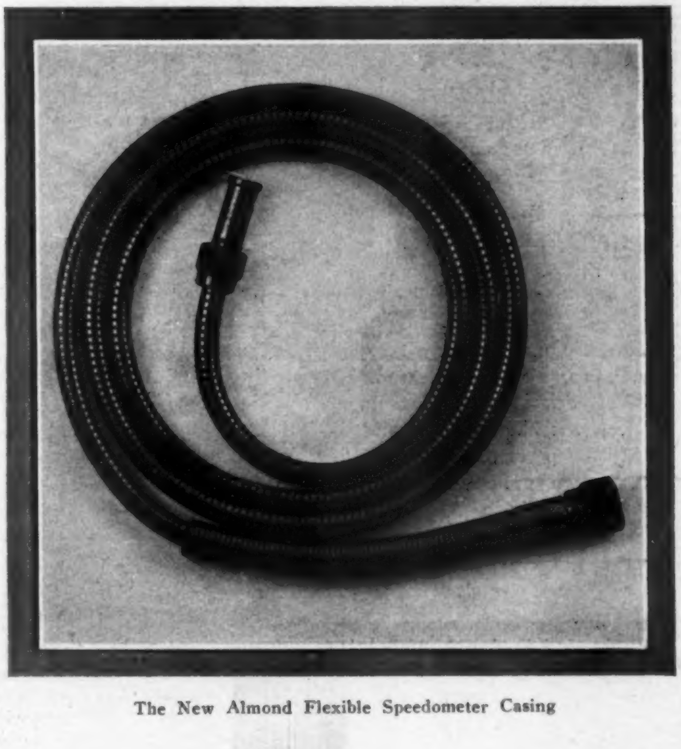
West Virginia—The local road revenues in the State of West Virginia should amount to $1,500,000.

Wisconsin—In Wisconsin there is available from the State appropriation $390,000, $350,000 of which is to be used for State-aid purposes and $40,000 for engineering and administrative purposes. The local revenues should amount to $3,000,000.

Wyoming—No State funds are available in Wyoming, but the local road revenues should amount to $500,000.

New Almond Speedometer Casing

THE illustration of the Almond flexible tubing as here presented is the newest effort along speedometer lines at the plant of the T. R. Almond Mfg. Co., of Ashburton, Mass., it being the idea in this flexible speedometer shaft to obtain the greatest possible measure of flexibility, coupled with excellence of material and careful workmanship, experience having taught that this is the right way to realize the fullest measure of life under exacting conditions of service. In the construction of this shaft two coils of wire are used, they being snugly encased within each other. The inner wire is a tempered steel spring with a flattened surface turned to the inside, thus forming a small smooth bore as the tube that supports the flexible shaft. The outer coil forms the oil-tight casing and is out of a continuous length of brass wire, specially shaped for this work. Ornamentation is realized due to the high finish that is given the outer brass wire. It is worthy of note that the built-up construction is tight and the outer material being rust-proof and highly polished, the deteriorating influence of service and weather is nil. In operation this casing conforms to the requirement including the curving around the obstructions that are natural to automobiles, and it has the special facility of operating without kinking, making its own radii of full and smooth curves.



The New Almond Flexible Speedometer Casing

New Things Among the Accessories

A New Speed-Mileage Meter

WORKING on a pneumatic principle, the Stover-Lang speed and mileage meter shown in Figs. 1, 2 and 3 is a new product on the market. It is made to register rate of travel by dividing the distance traveled by the time. The distance is counted by the revolutions of the road wheel. This is accomplished by means of the disc which is attached to the wheel and which has a cam-shaped protrusion that strikes a roller as the wheel rotates. By the aid of a diaphragm and rubber tube connections air is forced in puffs every half revolution of the wheel, which moves a gear two teeth for every revolution and denotes the exact distance traveled. By means of a clock escapement automatically wound, time periods of 5 seconds are used as a basis of calculations. At the end of every five seconds the count of the wheel revolutions is completed and a new count begun. The distance thus obtained is divided by the time. The mileage meter is connected directly with the gear which counts the revolutions and consequently registers the correct distance.

Fig. 1—Stover-Lang speed mileage meter, showing the connections and diaphragm

The trip mileage may be quickly set at any figure as well as at zero. The winding of the clock is effected from the outside of the case; likewise the hand setting. An electric lamp forms part of the fitting, and lights when pulled out, but remains extinguished while in the case, which is made of heavy brass with rounded corners, containing the speed meter, the mileage meter, the clock and the electric light and screws flat to the dash. The rubber tube connection is led under the bonnet through the dash into the back of the first case, thereby protecting the connections. The meter is manufactured by the Stover-Lang Company, 219 Columbus avenue, Boston, Mass.

Engine Starter and Lighting Outfit

TWO problems that have been attacked in various ways have been incorporated in the same instrument by The O'Neill Lighting Company. Starting and lighting the car are the two aims of the electric-torque generator manufactured by this firm. It consists of a special type of generator mechanism which may be connected with the shaft of the motor either by gear or silent chain, together with accumulators that float on the line acting as reservoirs. The generator is steel-clad and water- and dust proof. It has a 7-8-inch shaft mounted on ball bearings. The maximum output is obtained at a speed of ten miles per hour, remaining constant up to 60 miles per hour. Below the lower speed the accumulators that are kept charged when the generator is not being used for lighting afford the means of lighting and starting.

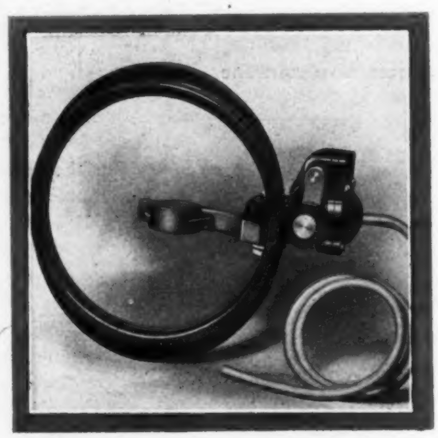


Fig. 2—Showing the method of drive employed on the Stover-Lang meter

In order to start the motor of the car, by pressing a button situated on the dash or the steering wheel the accumulators are cut into circuit with the generator that acts as a motor and turns the engine.

O'Neill safety headlights are supplied with the outfit and are fitted with 100-candle-power bulbs. These are placed between a front plano-convex lens that is fixed and a back hyperbolic mirrored lens that shifts. When the shifting lens is in focus with the light in conjunction with the front lens there is produced a broad field of near illumination and a long narrow distance light. By pulling a lever on the heelboard the lens is lowered and all the light cast downward in the near path of travel out of the line of vision of other traffic. The automatic electric system is manufactured by the O'Neill Lighting Company, Detroit, Mich.

Automobile Lighting Switch

IN connection with its automatic generator system of automobile lighting, the Hartman Electrical Manufacturing Company, of Mansfield, Ohio, has brought out a new type of dash switch for controlling the various circuits. This switch can be readily used with a straight storage battery as well as with the generator system for which it was designed. The switch is of the selective, drum type giving five combinations, viz., tail, tail-side, all lights with headlight dim, all lights bright and head-tail, the latter being for city driving. By means of a resistance coil, which is a part of the switch, the head light can be dimmed for city driving or when approaching another car. This switch proper is on the engine side of the dash, where connections with the various lighting circuits can be easily made. This switch requires only a 5-8-inch hole for the stem, which is threaded far enough so that the switch can be mounted on either a metal or wooden dash. It is held in place by means of hexagon nuts on either side and the work of installing requires but a few minutes. The dial, which appears on the front of the dash, is 2 1-4 inches in diameter. The switch handle is made removable so that when the driver leaves the car he can turn off the lights or leave them burn in any combination with the assurance that they will not be tampered with during his absence. The switch is furnished either with or without socket for trouble lamp.

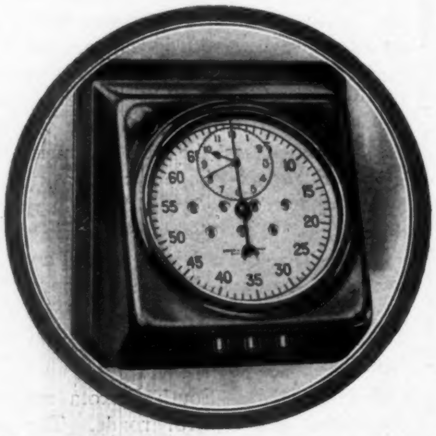


Fig. 3—General view of the clock, speed and mileage meter for dashboard attachment